



Surgery, Gynecology and Obstetrics

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FIG. 1. Relation of gall bladder to cystic, hepatic and common ducts. Note cystic duct lying on the inner side and overlapped by the polypoid of the gall bladder which is being drawn upward by the forceps. (From J. Mayo)

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RESTORATION OF THE BILE PASSAGE AFTER SERIOUS INJURY TO THE COMMON OR HEPATIC DUCTS¹

BY WILLIAM J. MAYO M.D. ROCHESTER, MINNESOTA

THE union of the cystic and hepatic ducts forms the common bile duct. The juncture does not occur in a fixed manner at a fixed point but its location varies in different individuals. It may be close to the fissure of the liver or at any point between the liver and the duodenum. The normal situation is about three quarters of an inch from the intralipatic portion of the hepatic duct. When the point of union is low the cystic duct may and usually does be parallel and adjacent to the hepatic duct. If found in this anomalous position the two ducts must be carefully separated in performing cholecystectomy in order to avoid the possibility of severing the hepatic duct.

In removing the gall bladder it should also be remembered that the cystic duct has its origin on the posterior wall above the lowest point and that the pelvis of the gall bladder usually overlaps the cystic duct on its anterior and inner aspects. Quite frequently there is a little fold of peritoneum connecting the pelvis of the gall bladder with the gastro-hepatic ligament over the common duct forming a small suspensory ligament. When this fold is present and is associated with marked inflammation there are often many adhesions in the little triangle thus formed. Since the fold lies in a line with the cavity of the gall bladder it may be mistaken by the inexperienced operator for the cystic

duct and the common or hepatic duct may be completely severed. In some instances a section of the duct has been removed. To avoid this accident the pelvis of the gall bladder should be carefully dissected from the triangle until the cystic duct is fully exposed, ligated and divided (Fig. 1, frontispiece).

The cystic artery usually passes behind and not along the cystic duct to the gall bladder. The relation of the artery to the duct is almost like that of a bowstring to a bow as it is shorter than the duct and lies on a plane closer to the liver. It sometimes happens therefore that the duct is securely grasped without catching the artery and when the tissues are divided the artery quickly retracts and bleeds freely. Hurried attempts to catch the artery with heavy rat tooth forceps may result in serious injury to the great duct. When cut this artery retracts into a pocket in Calot's triangle and the forefinger properly placed will check the bleeding at once. A few mouse tooth forceps can be caught in the tissues about the forefinger forming a little basket and by lifting on the forceps the finger can be removed and the artery caught with certainty.

Brewer (1) has shown that the cystic artery occasionally originates in the superior pancreaticoduodenal artery instead of in the hepatic and thus passes along the common and cystic ducts. In this location however,



Fig. 1. Adenobroma of the stump of the cystic duct after cholecystectomy causing common duct obstruction.

it is easy to control if the anatomical situation of the vessel is recognized.

Judd's (13) method of carefully catching the cystic duct and artery exposing them together and separating them from the notch of the liver while sealed in their connective tissue can ordinarily be employed and it obviates any danger of injury to the common and hepatic ducts.

It is the general experience (Jacobson 3) that injuries to the common and hepatic ducts are usually the result of various operative accidents. In the large majority of cases the accident is not discovered at the time of the operation but only after the

patient has developed a permanent biliary stasis or jaundice and other symptoms of obstruction. In a small minority the obstruction is the result of cicatricial tissue from gall-stone ulceration. Such obstructions are more frequently due to stones impacted in the cystic duct at the juncture of the common duct than to stones in the common duct itself. The free portion of the common duct has an extraordinary capacity for dilatation which is not true of the cystic duct. Ulceration does occur from stones within the common duct and leads to the formation of stricture, but in our experience such strictures have been found in that portion of the common duct which is fixed in the head of the pancreas.

Benign tumors of the stump of the cystic duct may occur after cholecystectomy and cause obstruction of the common duct. There have been two examples in our clinic of true fibroadenomata of the remaining portion of the cystic duct subsequent to cholecystectomy. The tumors were nearly the size of a hazelnut and more or less encapsulated. They caused typical symptoms of common duct obstruction with the syndromes of Charcot, i. e., colic, fever, chills, sensations, and exacerbations of jaundice. Both patients were cured by removal of the tumor and the stump of the cystic duct (Fig. 2).

Operations for the restoration of the common bile duct are usually of a formidable nature, not only because of difficult technique, but because of the poor condition in which these patients usually come to the surgeon. As a result of the former operation and continuation of the local irritation, there are always extensive adhesions, and in these adhesions are an unusual number of thin walled veins which tear readily and flood the field with blood or keep up a continuous oozing thus adding to the difficulties of the operative procedure.

The cystic and common ducts lie very close to the median line and as the operation of cholecystectomy is the one that is now usually employed, the incision, whether for primary or secondary operation on the biliary tract should be made rather close to

the midline, usually not more than two inches to the outer side. Bevan's incision (4) is most appropriate in the secondary operation. It begins at the ensiform cartilage, extends directly downward for one and one half inches, then divides the upper half of the right rectus muscle on a line with the costal margin and about one inch from it. The longitudinal part of the incision should, if possible, be kept inside the original incision. All the bleeding vessels must be ligated, as they have a strong tendency to bleed after the operation even when they are quite small. It is especially important to tie the vessels situated in the subcutaneous tissues and skin, vessels in the muscles have less tendency to bleed after temporary clamping.

Excision or resection of the obstructed portion of the common duct with end to end union. The strictured portion of the duct is usually in the vicinity of the junction of the cystic and common ducts and is from one fourth to three-fourths of an inch in length, at least these have been about the extremes in cases we have operated on. Resections of this character demand rather exact technique. Adhesions are divided carefully and ligated rather than separated. The duodenum and stomach will be found adherent to the gall-bladder notch, often completely overlying the common duct. This necessitates dissection of these structures until the margin of the gastrohepatic ligament can be identified. The foramen of Winslow is cleared and the second portion of the duodenum, if overlying the strictured area is dissected from its position. There will be little difficulty in identifying the hepatic duct by the telltale bile escaping from the fistula if there is one or by an opening made into the stump of the hepatic duct in the course of the dissection. It is surprising how easily the common duct may be found simply by carrying the dissection from the end of the hepatic duct directly through the strictured area along the margin of the gastrohepatic ligament. One would expect the distal end of the common duct to be contracted but even after many months of complete obstruction it will be found normal in size. The stricture is dissected out until the ends of the hepatic and common



Fig 3 End of common and hepatic ducts sutured with through and through chromic catgut. Dotted line shows where the end of the common duct is enlarged by short longitudinal incision.

ducts be free, then several chromic catgut stay sutures are introduced catching the tissues behind the duct ends which when tied obliterate the posterior space and draw the hepatic and common ducts into position for suturing. A few catgut through-and-through sutures are placed so as to unite the duct ends posteriorly. The open end of the common duct is split along the anterior surface one third of an inch as advised by C. H. Mayo (5) (Fig 3). The split in the free border of the common duct increases its caliber to a considerable extent, it is thus more readily coapted to the dilated hepatic duct. A "T" tube of appropriate size is now introduced, one arm extending about one inch into the hepatic duct to the primary division, and the other arm if possible, through the entire length of the common duct until its free end passes into the duodenum (Fig 4). The gap is closed about the "T" tube with chromic catgut sutures the tube fastened with an absorbable suture to the hepatic and common ducts, respectively and the line of union covered by such omental and peritoneal tissues as may be available for the purpose. With a syringe, normal salt solution is forced through

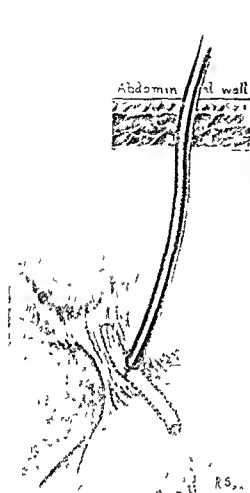


Fig. 4. 'T' tube in place. Duct ends sutured about it.

the "T" tube until it passes freely into the duodenum (McArthur 6) and a few rubber-tissue drains are appropriately arranged. If possible gauze should not be introduced in any form down to the line of union, as it tends to the formation of fistulae. If necessary, a piece of rubber tubing may be placed in Morison's pouch in the right renal area and carried out through a stab wound in the loin. As a rule when the "T" tube is used for reconstructions of the common duct it is not removed for about three weeks, at which time firm union will be established.

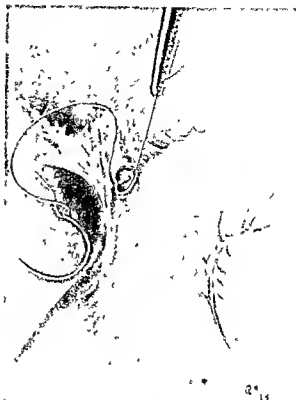


Fig. 5. Direct union of hepatic duct to duodenum. Gall bladder has been removed. Continuous chromic catgut sutures have been placed uniting posterior wall. The stay sutures holding hepatic duct to duodenum, of interrupted chromic catgut lig. behind this suture and are not shown.

Strictured area of the common duct dilated with dilating forceps. For those cases in which the stricture is in the pancreatic portion of the duct, the result of ulceration it has been found satisfactory to open the common duct and pass a pair of dilating forceps through the strictured area until it is completely dilated. Strictures in this vicinity are usually of the character of a diaphragm and will often pop like paper on passing forceps through them into the duodenum. In the more difficult cases it will occasionally be found necessary to open the duodenum and expose the papilla before undertaking division of the stricture. After division, a "T" tube is placed in the duct,



Fig. 6. *a* Rubber tube in place and fastened by chromic catgut suture to the hepatic duct. Anterior layer of chromic catgut continued. *b*, Duodenum being sutured to enfold anastomosis; the area later to be covered by omentum.

one arm of the tube being sufficiently long to pass completely into the duodenum.

Extensive injuries to the great bile duct necessitating union of hepatic duct to the duodenum. In the more extensive injuries it may be necessary to suture the hepatic duct directly to the duodenum. The first case operated on in this clinic was reported in 1905 (7) and the patient is well now after more than ten years. It is of interest that since the operation she has borne several children and has had some severe illnesses, not however connected with the biliary tract.

Two row suture anastomosis. In our experience in these cases the stomach and duodenum have been found closely adherent to the site of the injury. If care is used not to separate these adhesions too extensively the duodenum may be so closely approximated to the dilated hepatic duct as to secure a two row anastomosis without great difficulty on the general principles of gastrointestinal union; the omentum being carefully sutured around the anastomosis with fine chromic catgut. In one case in which there was a contracted gall-bladder about one inch in length it was possible to make a pedunculated flap of the gall bladder and fill in a considerable gap thus bridg-

ing a defect which the duodenum could not be mobilized sufficiently to overcome. In another instance a small flap was dissected from the duodenum in a manner somewhat similar to that carried out by Walton (8).

Union by rubber tube of the common or hepatic duct to the duodenum. To Sullivan (9) belongs the credit of having shown the possibility of uniting the hepatic or common duct with the duodenum by means of a rubber tube and leaving it as a more or less permanent connecting link surrounded by omentum. This is by all means the most simple method of restoring the bile channel but unfortunately the newly formed channel is not mucus-lined and we must expect that eventually contraction will take place after the rubber tube slips into the intestine, which will ultimately occur. However, we have not found it difficult to combine this method with direct union of the hepatic or common duct to the duodenum and results with this combined operation have been excellent.

Technique of the procedure. The hepatic duct is united as well as possible by a mucous suture to an opening made into the duodenum and a rubber tube introduced and sutured into position. The suture is continued in a manner so that at least some portion of the new canal may be mucus-lined.

The line of union is, of course, not bile tight, but by surrounding it with omentum it does not seem to leak into the peritoneal cavity. The tube extends into the hepatic duct to the primary division and about one inch into the duodenum. After absorption of the holding sutures, the rubber tube readily passes into the intestinal tract. This is the operation of choice in the majority of cases and a number of our patients have been cured by it (Figs. 5 and 6).

Direct union of the common duct to the duodenum. This method has been used in our clinic several times following resection of the common duct for cancer and once following partial gastrectomy for cancer of the pyloric end of the stomach. After removing the involved portion of the common duct the distal end is tied, the stump covered with peritonium and the proximal end united to the duodenum after the method of Coffey. The method is applicable in primary operations when the liver end of the duct is easily accessible. In secondary operations there are, as a rule, so many adhesions that the duct cannot be sufficiently mobilized to accomplish it. Our experience in resections of the common duct for cancer in restoration of the

biliary channel by any method has been discouraging. Two of these patients died soon after operation and those who recovered lived less than eighteen months, in none of them, however, was death directly associated with this particular feature of the operation.

REFERENCES

1. BRYANT, G. I. Some observations upon the surgical anatomy of the gall bladder and ducts. *Ann. N. Y. Acad. Sci.* 1915, 19: 306.
2. JENNINGS, J. H. Repair and reconstruction of the bile ducts. *Tr. Am. Ass. Obst. & Gynec.* 1915, 19: 188.
3. BRYANT, G. I. A new incision for the surgery of the bile tracts. *J. Am. M. Ass.* 1907, xxviii: 175.
4. MAYO, C. H. The critical importance of the gastro-intestinal tract in the surgical importance. *J. Am. M. Ass.* 1912, lxx: 60.
5. McARTHUR, I. L. Further advances in the therapeutic use of the bile tracts. *N. Y. M. J.* 1915, xci: 118.
6. MAYO, W. J. Some observations of cases involving operative loss of continuity of the common bile duct with report of a case of anastomosis between the hepatic duct and the duodenum. *Ann. Surg. Phila.* 1905, ciii: 60.
7. WATSON, A. J. Reconstruction of the common bile duct. *Surg. Gynec. & Obst.* 1911, xxi: 60.
8. SULLIVAN, A. G. Reconstruction of the bile duct. *J. Am. M. Ass.* 1909, lvi: 774.

ADDRESS OF THE RETIRING PRESIDENT OF THE CLINICAL CONGRESS OF SURGEONS OF NORTH AMERICA¹

BY JOHN B. MURPHY, M.D., F.A.C.S., CHICAGO

ON behalf of the Executive Officers of the Congress, I greet you, I bid you welcome to the city of Boston—the hub of learning of the western hemisphere. We keenly appreciate the warm words of welcome from the Chairman of the Committee on Arrangements, Dr. Fred B. Lund, and thank him sincerely for them. I congratulate you on the opportunity afforded of availing yourselves of the many advantages for education and inspiration which the city of Boston, its people, and its profession will place at your disposal.

I congratulate the city of Boston on being the host to such a grand body of busy men who have made so many sacrifices that they may improve themselves and bring to the people dependent upon them, a better and more worthy service; that they may make themselves more deserving of that praiseworthy and unlimited confidence which the people of America place in their medical men.

This, the sixth session of the Clinical Congress of Surgeons of North America, bids fair to be a conspicuous milestone in the work of this organization. As its retiring president, permit me again to thank you for the honor and privilege of presiding over this body, for the honor of being a party to and a part of an organization which has achieved so much in stimulating the desire for scientific clinical observation and for standardization of the practice of surgery.

In describing the work of the organization, it seems to me fitting to use the scriptural quotation from the seventh chapter of Matthew "By their fruits ye shall know them."

Let us refer for a moment to the origin of the organization, then I am sure we shall better appreciate and more keenly value its fruitage. The size and popularity of this organization is a sequence of a general desire for closer contact and personal intercourse with the clinical workings of surgery.

There was one man who had the vision, who outlined the organization, who took up the task of its foundation; and by the positiveness of his conviction, by his indefatigable zeal, by his indifference to rebuff and contumely, by a courage founded on the knowledge that he was working unselfishly for a great and good cause, by his fidelity to the medical profession and his confidence that the majority of its members would finally appreciate the true worth of the purposes of the organization, he succeeded in founding the Clinical Congress of Surgeons of North America. He first inspired a few and then gathered a large number and finally convinced a coterie of men that the opportunity was at hand and the material available. I refer to its founder and present secretary, Dr. Franklin H. Martin.

The opposition grew fairly apace with the growth and popularity of the movement. Oppositions, honest and prejudiced, innocent and designing, were encountered by its founders, but these are essential psychologic necessities to the substantial and rugged growth of any great evolutionary economic, political, religious, social, or educational movement. If a cause cannot overcome such opposition, the cause is either untimely, unworthy, or poorly manned.

The advantages of an organization as outlined were soon appreciated by a large number of the practicing surgeons of the country, and the privileges which it granted and the strength which it afforded the individual by seeing others work and comparing that with his own soon gave the movement an impetus that has carried it everywhere in the western hemisphere.

In what way did the organization of the Clinical Congress of Surgeons plan its sessions to differ from the regular medical meeting? It planned to substitute an exclusively clinical meeting for the literary programs with volunteer papers and volunteer discussions.

¹ Read before the Clinical Congress of Surgeons of North America, Boston, Oct. 27-28, 1913.

which prevailed up to that time; it further planned that this body of men should undertake the introduction of certain definite changes in the practice and ethics of surgery and that it should institute or foster public efforts in research topics of general health interest from a prophylactic standpoint; as of cancer, tuberculosis, etc

The pristine moral standards of the medical profession in relation to the public must be retained or restored to their former ideal responsibility to the people and the peoples interest. The leaders in that movement are bearing the penalties and pains which all must obviously bear if the purpose is worthy, and the individuals are strong, fearless, and plain spoken in their propaganda. Some men may perish in the work, but the cause is great and the reformation so obviously needed that no force which the reactionaries can resort to will prevail against this movement. Conditions are superior to men and ultimately triumph. To break through the bonds of tradition has always been primarily an odious task, but with educational, moral, and economic conditions demanding advance, success usually crowns a well guided, sustained, renewed, and accumulative effort.

It has been a vast, far-seeing, comprehensive movement, and its perpetuity is therefore assured. The effect of the Clinical Congress of Surgeons of North America as a teaching and influential organization can be noted now in practically all medical association meetings, they all now have clinical hours or days.

Just two weeks ago I attended a meeting of the Southwestern Medical Association at Oklahoma City, Oklahoma. Half of each day was allotted to clinics and clinical demonstrations by members of the local profession. These clinics were so well conducted that they would have been a credit to any metropolitan medical university, and every available space in the rooms was occupied by men eager to see and capable of appreciating. They did all classes of operations, and after the most modern and approved plans. The instructions in the medical school were from a practical standpoint high-class and on a par with the more modern eastern schools, except

that the students were given less predigested education. Their hours of instruction were reduced, giving them a proportionate added opportunity for individual thinking.

Oklahoma City! It seems to me it was but yesterday that it was an Indian reservation. This example shows how the standardization of surgical procedures and medical teaching has been extended, and many of the men who gave the clinics in Oklahoma City are in attendance at this meeting, seeking new inspiration and observing the most modern in the art of clinical surgery. The so-called frontiers of surgery have elevated the general average of their men much more rapidly than the older and more staid communities. The latter self-satisfied centers have not yet learned the advantage of frequent visits to neighboring clinics and have therefore not profited by them.

But to return to the organization. The popularity of clinical meetings and the enthusiasm of the men have created a demand for admission far in excess of the amphitheater capacities of the largest cities of the world, for example, approximately only one third of those who applied for tickets to this Boston meeting could be accepted.

The scope of this clinical movement was made not only national but international, including all the countries of North America, and by invitation of the English surgeons it invaded the British Isles. Its idea was that the teaching of surgery and medicine by clinical meetings should be international and world wide if the best results for all are to obtain. Through its clinics it creates an international fellowship and an interscientific relationship that scarcely could be produced in any other way. It brings the United States, Canada, and other countries of North America into the closest relationship. It emphasizes the doing of things rather than the telling. It distinguishes the practical man from the theoretic and academic man. It is to be hoped that the purely internal medicine departments will soon take advantage of a similar organization.

The Congress through the colossal force of its numbers and the standing and work of its members had a right to speak and act for the

surgeons of the Continent. In that capacity, it appointed the organization committee that founded the American College of Surgeons.

The purpose of the College of Surgeons is to elevate the individual, to encourage him to do the highest types of surgical work, by encouraging a better preliminary education, by demanding a longer medical course, by favoring a prolonged resident internship and by urging a service as assistant or associate in a clinic of merit. By asking him to keep reports and exact records of his cases, it causes him to think, to compare these with the published work of others, and therefore should increase his efficiency. By improving the individual it hopes to elevate the mass, which can be done only in this way.

The membership and standing of that body commands the respect and confidence of the profession of the world. Its ideals and its practices are of the highest scientific and ethical standing. There is no organization in the history of medicine that has acquired such a momentum for good in so short a period of time.

The Congress has appointed a hospital efficiency committee to cooperate with like committees in other associations for the purpose of bringing together the superintendents and managers of hospitals, to formulate plans for increasing the teaching capacity and elevating the scientific and moral tone of hospital work, and we are sure that the hospital managements will welcome the aid that will be given to them by this committee.

It also appointed a committee on cancer publicity, that eventuated in the organization of the American Society for the Control of Cancer, the purpose of which is to train the laity to recognize the causal and early factors of cancer and to stimulate them to prompt and rational action in eliminating them.

Its next important work will be to favor and advance to fruition the movement so wisely and forcefully advocated by Dr. William L. Rodman, President of the American Medical Association, to establish a National Examining Board before which a practitioner in the United States may appear, present his

credentials and pass an examination for a license to practice in any part of the United States, its territories, or extra oceanic possessions, the consummation of which is devoutly to be wished for.

The Congress is committed to the principle of education of the general public through the lay press, and the coming year it will take up this field of work in an organized and systematic manner. The profession can have no more ardent supporter than a properly informed lay public. The medical profession cannot advance materially in its practice beyond the range of lay information. The time has come when there is nothing known to the profession that cannot be confidently submitted to the general public through the lay press. This work must not be retarded by the blighting effect of obsolete traditions and customs. During the period of empirical medicine it was not advantageous to the people nor to the profession to communicate its knowledge to the then illy informed laity, but the dissemination to the public of a knowledge based on science, grounded in facts, practiced honestly but fearlessly, can have its range of usefulness increased by the cooperation of an enlightened public. No one has greater respect for medicine or more confidence in its doctors than those who are most exactly informed on its scientific attainments and most intimately conversant with its integrity and its ethics. We never will have medicine freed of its isms, freed from malignant attacks, freed from its imposters and counterfeiters until the public is informed frankly, openly, and unreservedly on all of its work. Publicity must be the slogan. That in medicine which cannot bear the light of day deserves to be and should be eradicated. The enormous service that can be rendered in the conservation of life, in the prophylaxis of disease, is shown by the reduced mortality, through the cooperation of the people from small pox, typhoid fever, appendicitis, tuberculosis, etc. Let us have the public as well informed on all medical topics as they are on these.

The organization of the Clinical Congress of Surgeons of North America is simple, under the control of a committee representing

its ex-presidents. It seeks to emphasize the scientific in medicine and minimize the politics thereof. It is held together by the cohesiveness of the mutual advantages to its members. Its first meeting was held in Chicago in 1910 with an attendance of about 1,200. Its second meeting was held in Philadelphia, its third in New York, its fourth in Chicago, its fifth in London. In each of these cities the work of the clinicians and teachers was of an exceptionally high character. The surgeons of England were attracted by the principles and advantages of the methods of the Congress, and in 1913 extended to the Congress an invitation to hold its 1914 meeting in London. It was, from an instruction point of view, one of the most successful meetings ever held in London. There were over 1,000 Americans and as many Britons in attendance, and it is a pleasure to state, as its presiding officer, that while the British surgeons were playing in a new rôle and under altered conditions, they acquitted themselves superbly. They had their material classified, the men were in their amphitheatres on time, they performed their operations with dexterity and skill, they were painstaking in elaborating all of the details of the science and art of surgery in that metropolis of surgery of the world. They were genuinely cordial; they were hospitable and their work was keenly appreciated by their American as well as by their English colleagues. It was with saddened hearts that the Americans left London at the end of the last week of European peace, the horrors of the following week were only too plainly visible and the end is not yet. We feel a deep sense of obligation to the London and English surgeons for their generosity to the Congress.

This organization has, above all, endeavored to democratize surgical teaching and surgical education. It is imbued with the spirit that every medical man is entitled to an opportunity for better education, personal

observation and better mental and technical equipment, and that he may obtain it from any source at which it may be found recognized or unrecognized by previous achievement. In other words, that the unknown man in the city in which the Congress is held, if he has a mission, a word to deliver, a demonstration to make, a theory to promulgate, is granted an audience, he is weighed by this discriminating body and if his work bears the scrutiny of these men his future in the profession is established, regardless of his previous prestige or his inherited opportunity. I know of no better segregator of the worthy and unworthy than this body.

It has been the purpose of this association to make every man feel that it is interested in his betterment and the organization through its growth and influence is assured of a reciprocal support from the individual member. No organization can accomplish its best purposes on any other basis. Kipling's "Law of the Jungle" forcefully expresses this principle:

Now this is the law of the jungle
As old and as true as the sun
As the wolf that shall keep it may prosper
But the wolf that shall break it must die
As the creeper that girdles the tree trunk
The law runneth forward and I back
For the strength of the pack is the wolf
And the strength of the wolf is the pack

Now, as your retiring president I wish to thank you for the cooperation and support which you have so cordially and continuously extended to me. The supreme pleasure of my official position comes at this moment, as I transfer the gavel of the presidency of the Clinical Congress of Surgeons of North America to your president elect, one of God's democratic noblemen, who was born in frontier obscurity, reared in humility, imbued with ambition and integrity, who created an opportunity, forced a recognition, and commands admiration. A master in science, an artist in surgery, a samaritan in religion and above all a man — Dr. Charles H. Mayo of — the world.

ERRORS IN ANATOMICAL DEVELOPMENT: THEIR CAUSE AND SURGICAL SIGNIFICANCE¹

By CHARLES H. MAYO, MD, FACS, ROCHESTER, MINNESOTA

ERRORS of development are always of exceeding interest, some of them because of rare or curious features of the deformity and others because of their serious or fatal import. Only when studied in large numbers does one find these deformities occurring in a manner so regular that scientific interest in their causation is aroused, and the fact is quickly appreciated that errors of development occur in the cleavage lines of advance from lower to higher forms of life.

Many anomalies are seen in domestic animals, those occurring in the lower forms of life usually perish in the struggle for existence. Those occurring in the human family may be remedied or the life of the individual may be preserved by care. The superiority of the vertebrate over the invertebrate lies in the extraordinary development of the nervous system and for one-third of the gestation period it represents one half of the body growth. The change of the invertebrate to the vertebrate not only concerns the nervous system but is just as important in the intestinal system and in the organs of nutrition and elimination. Anomalies of these structures which represent the superiority of the vertebrate are fraught with the most serious consequences.

Of much less serious import are most errors associated with variations in circulation that are not primarily incompatible with life. This is also true of errors due to inclusion of the elements of the skin in the midline, leading to the development of simple dermoids as well as to failure of union of the branchial clefts, which represent the gills of the fish type.

In searching for cleavage-lines in the process of development it is usually easy to follow changes that have occurred by comparing animals of nearly similar types. This is a long step to the development of man, nevertheless the tracing has been gradual and the

gaps filled so that the missing link from animal to man is neither mysterious nor so far removed as the tracing of similar changes among lower animals of the distant past when new types which still persist, appeared from time to time. This has been especially true in the great change from invertebrate to vertebrate. All progress has been identified by such changes in the predominant species of any period which has enabled them to live in a different medium and to be sustained by different nutrition. Thus from sea life came the amphibians in some of which the swim-bladder changed into primitive lungs, others respired by the skin. Occasionally changes have occurred through the degeneration of the predominant species, in this manner the tunicata developed.

In a consideration of the causes of errors of development it is useless to study the changes in vertebrates alone as during one-third of the period of gestation the vertebrates are almost alike in their development. In following the forms of life from the most primitive types it is seen that the higher only have opportunities for many abnormalities and that man has the greatest assortment since abnormality of mind must be included. Consequently such a study forces the student back to a consideration of invertebrate life.

In the higher invertebrates such as the limulus the peculiarity of development was a single straight gut connected with a cephalic stomach, the nervous system consisted of special sense-organs, olfactory and optic, the supra-oesophageal nerve ganglia connected with the infra-oesophageal or segmented nervous system by the oesophageal commissure, the latter acting similar to the crura cerebri of man. The shell or chitinous membrane is like cartilage in man and so also is the comparison of glands and organs of special sense. These species, having a nervous system which surrounded the gullet, were necessarily limited as to their development

¹Read before the Clinical Congress of Surgeons of North America, Boston, October 25-30, 1915.

since the greater their nervous system and ability to find and catch their prey the less their ability to eat it and they became the blood suckers. The peculiarity of the nervous system, however, was such that it grew over the cephalic stomach exactly to conform with the growth of the nervous system over the ventricles of the vertebrate brain. Between the collections of nerve tissue on the cephalic stomach are placed masses of digestive glands which resemble the cells of the liver and pancreas. In these higher invertebrates the digestive action is limited because of the high type of food ingested.

The invertebrate has a nervous system in front of the intestine while the vertebrate is characterized by having the intestinal system in front of the nervous system. Some students led by Hilaire (1) have claimed that the change from the invertebrate to vertebrate required that some lower type of life should reverse the surface and start swimming on its back, the ventral becoming the dorsal, the mouth also changing position. It doesn't seem possible to explain the reversal of the nervous and intestinal systems in any other way unless Bateson's (2) simple theory is accepted, that they developed from the beginning as two types, one with the nervous system in front of, the other behind, the intestinal tract. The later, more tenable theory of Gaskell (3) has grown in favor and explains these changes along lines of limitation of type as variations of body structure necessitated radical changes to maintain progressive development.

If one considers the structure of the nervous system and its ventricles, the central or neural canal and its terminus in the first period of gestation, he will find that it is almost exactly like the cephalic stomach and straight gut of the invertebrate. The infundibulum as a tube connects the third ventricle with the ventral surface exactly in the same position with reference to the spinal ganglia and special sense-organs, so that one might speak of this structure as an esophagus connected with the cephalic stomach, while at the caudal extremity, through the oculo-enteric canal it is connected in the human embryo during the first weeks of life with the rectum just above its outlet.

The gullet of the invertebrate disappeared within the skull, taking with it the pituitary gland, the area thus vacated being marked in embryonic life by a pharyngeal depression called "Rathkas pouch"; this marks the site of the invertebrate mouth. The thyroid went down through the tongue to its cervical location. Both of these glands had to do with development, stature, nutrition and sex.

The pituitary did not develop from the infundibulum as it exists in the same position on the esophagus of the invertebrate. In the region of the infundibulum and of the hypophysis, because of developmental change or reversion, theoretically should be found the same types of tumors (that is, dermoids, cysts and teratomata) as are found at the caudal extremity of the neural canal which has also lost its opening. It is a satisfaction to state that such have been reported by several observers, among them Hecht (4) who reported a dermoid, and Cushing (5) a dermoid and cysts.

By such change the cephalic stomach and straight gut disappeared to become the ventricles of the brain and neural canal which necessitated the ventral development of an intestinal system and the upward and backward growth of the segmented nervous system surrounding the spinal canal. The neural canal in the human embryo is lined by a single row of ciliated columnar cells, the cilia of which disappear at the third month. The nerve-cells are arranged in regular groups over the cephalic stomach and, becoming bunched or approaching each other, infold the membranous area between them which becomes the choroid plexuses. In the limulus, the highest invertebrate, the membrane between these groups of nerve tissue is covered by cell-bodies which resemble those of the liver and pancreas and aid in the moderate digestion required for the assimilation of very highly developed food. In ammocetes, the lowest vertebrate, the vestigial remains of such degenerated structure is seen covering a portion of the ventricles between the gray matter and, as shown by Gaskell (3), enables a small brain to fill a cavity otherwise too large for it. The cerebrospinal fluid is formed as a secretion of the choroid plexuses and is

found filling the ventricles and neural canal in the third month of the human embryo, which shows the period of the closure of these spaces. This fluid passes through the main liters which connect the various ventricles and filters through the thin membranes of the brain and cord, equalizing the pressure at all points. To maintain equilibrium of pressure, the absorption is carried on by the pacchionian bodies and a limited lymphatic system, the great bulk, however, being carried by the veins of the arachnoid space.

An increase in the tension of the cerebrospinal fluid may be caused by loss of equilibrium between production and absorption of fluid, vestigial remains of the old digestive glands of the cephalic stomach might be stimulated into activity by chemical irritants or food. This increase in fluid has been experimentally produced by blocking certain sters and by the injection of certain irritants into the ventricles. It also appears through the growth of tumors. Treatment of the axolotl and frogs in their earliest development with 7 and 6 per cent salt solution seems to cause the frequent appearance of spina bifida. Spemann (6), by suture injury of lower forms of life, created double headed monsters. Stockard (7) repeatedly caused Cyclopean monsters to develop from artificially fertilized eggs treated with magnesium chloride. Mall (8) reports many examples of artificially developed monsters, showing that monsters appear from interference with the germ, the egg or foetal development.

In the vertebrate brain, including the human, a pineal body represents the vestigial remains of the third eye found in some of the invertebrates. Cranium-fused monsters may have a fused third eye, but the true Cyclopean eye must come from the pineal body. Such monsters are rare and incompatible with life as the cerebrum is necessarily nearly or quite missing.

Inasmuch as all life originally developed in sea water and, as stated before, the progress in the development of animal life having come from its ability to change the media in which it lived by a new development or change in its structure, one can readily understand how salt solution or magnesium might

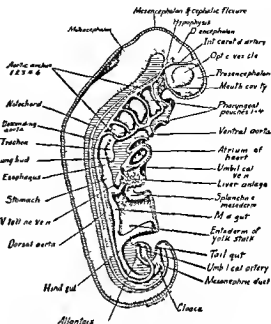


Fig. 1. Diagrammatic reconstruction of a 42 mm human embryo viewed from the right side (adapted from a model by His) (Prentiss Embryology).

inhibit the development of that structure which had changed to enable existence in a different medium. This is undoubtedly one of the reasons why sea life leaves the medium in which it lives to spawn. Salmon are a high type of fish and they spawn in fresh water, theoretically, treating their eggs with sea water should cause errors in development reverting toward the parent stock. All things in nature have a reason for their occurrence and this is undoubtedly an example. May it not explain the action of the parathyroid bodies that are supposed to maintain the stability of the mineral salts?

Anomalies of development of the spine and head are associated with overproduction of fluid or its escape as seen in hydrocephalus or anencephalus. Midline cranial tumors of the meninges alone or including brain matter are seen with all degrees of failure to close, even the entire neural canal posteriorly remaining open. This is known as rachischisis—small openings with protrusion of membranes or including portions of the cord down to the spina bifida occulta in which the opening and protrusion without persisting

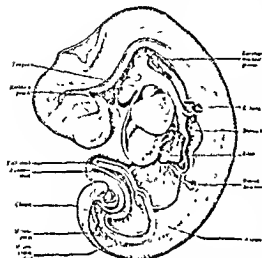


Fig. 2. Reconstruction of a 5 mm. human embryo showing the embryonic canal and its derivatives (this in Kollman's Atlas) (Prof. C. M. G. G.)

tumors prevented the development of bony covering during embryonic life. These areas are marked by thickened tissue, including the skin which has an excessive local growth of hair. Formerly these conditions were attributed to failure of the bony canal to close, permitting the protrusion to occur, but they are due to an excessive development of fluid, with protrusion of the membrane, which prevents development or union of the bony covering.

Anterior meningocele is rarely seen. Those noted have usually been in females and have caused obstruction of the alimentary canal by filling the pelvis. Nearly all such persons have died when operated on. One case has been reported from our clinic with recovery. The majority of spina bifida occur in the lower region because of the late closure of the lower end of the neural canal. These may be pure meningoceles or may contain also cord elements and may then be associated with varying degrees of talipes, occasionally accompanied by paralysis of the sphincters. Moore's (9) statistics of reported cases show 23 per cent of spina bifida to be sacral, 34 per cent lumbar, 29 per cent lumbosacral, 4.5 per cent dorsal, 0.5 per cent cervical, and two cases were occipital.

In hydrocephalus and spina bifida more careful study must be made of the choroid plexuses for vestigial remains of a digestive apparatus; also, in spina bifida and rachischisis the central canal, the "area medullo vasculosa" of von Recklinghausen, being open and having the appearance of mucous membrane, must be analogous to the invertebrate intestine.

In the earlier development of the vertebrate the nervous system is much longer than the notochord from which develops the spinal column of the higher vertebrates. The neuro-enteric canal closes in the third week of gestation. This, with some of the posterior rectal tissue and its own nerve tissue, becomes atrophied to a small mass known as the coccygeal body at the end and inner side of the coccyx which is often the center of true or neurotic complaint. The neural canal is attached to the posterior surface of the coccyx and steadies the spinal cord, the lower neural canal becoming a firm filament known as the "fila terminus" extending from the coccyx to the end of the spinal cord somewhere between the first and third lumbar vertebra. The filament and the cauda equina are produced by traction from the rapid growth of the spinal column which from being originally shorter outgrows it one third.

All that is known of the causation of talipes has been the association with lumbar involvement of the cord by varying degrees of spina bifida. To make progress in the study of its causation the lumbar enlargement of the cord must be examined for evidence of increased development of third late in gestation or for a separation of the attachment of the terminal filament, causing undue traction on the nerves of the cauda equina. Spina bifida occulta should be looked for in talipes, a condition in which a beginning spina bifida would be sufficient to prevent completion of the bony covering of the cord and, then receding, leave an adhesion which from the rapid growth of the spine causes destruction by undue stretching of the posterior nerve-tracts to the legs.

The roentgen ray will show these bony deficiencies and surgery may yet have much in

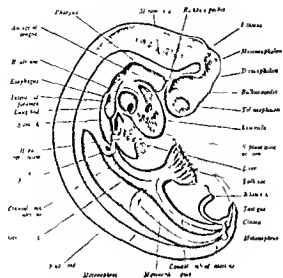


Fig. 3. Median sagittal dissection of a pig embryo of 6 mm to show viscera and neural tube (Prentiss Embryology.)

store for these sufferers in the way of dividing bands and freeing adhesions. Work along this line has been done by Jones (10) and by Sever (11). In this connection scoliosis in theory should be due to a failure of proper development of the notochord from which by segmentation spring the bodies of the vertebrae. This may be intrinsic or due to faulty development of the segmented nerves which surround the neural tube.

Dermoid tumors sacrococcygeal in type are very common and are caused by the rapid growth of the spinal column producing traction on the neural canal which originally reached to the skin of this region. Here also are found the teratomata from the coccygeal body. These tumors contain mucous membrane from the post anal bowel nerve tissue from the neural tube, bone and cartilage from the coccyx and various inclusions of surrounding tissue. Some of them have mucous cysts lined with ciliated epithelium from the neural tube showing the misplacement of tissue to have occurred before the third month of gestation.

In the development of the new intestinal system from the yolk sac it divides into fore mid and hind gut. At the pharyngeal end this divides into an oesophagus and respira-

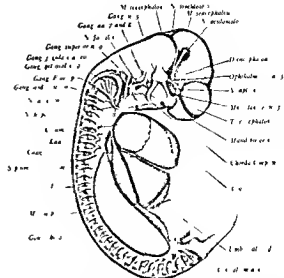


Fig. 4. Lateral dissection of a 10 mm pig embryo showing the viscera and nervous system from the right side. The eye has been removed and the otic vesicle is represented by a broken line. The ventral roots of the spinal nerves are not indicated (Prentiss Embryology.)

tory system. At an early period in the cavity of the stomatodaeum (developing mouth and pharynx) the pharyngeal end is closed by a membrane of ectoderm and ectoderm separating the oesophagus and trachea from the pharynx. This disappears about the fifteenth day its persistence being almost unknown. In this region are found certain failures of union of the gills or branchial arches and fissures causing harelip cleft palate, branchial cysts and similar deformities. The thyroid passing between the three portions of the tongue in its development, comes to rest astride the trachea below the cricoid cartilage and its anomalies consist in the remains of all or part of it in its lingual position and in the separation of embryonic pharyngeal mucosa causing midline thyroglossal duct cysts. These are located about the hyoid often passing through a small opening in its body over or under it to a pocket behind. They tend to recur after operation unless searched for and removed.

At the caudal end of the body there is a most interesting group of anomalies. In early fetal life the developing bladder and rectum are one. The anterior portion of the

cloacal cavity consists of the allantois and wolffian ducts from which are developed the sex organs and the urinary collecting system. The kidney secreting substance extends as mesothelial bodies or nephrogenic tissue from lower dorsal down to the second sacral vertebra. They lie close together with the aorta between. This substance is supplied by many blood vessels derived from a delicate plexus surrounding and connecting with the aorta. From a pouch which early appears from the lower portion of the wolffian duct are developed the ureter and pelvis of the kidney. This collecting portion becomes attached to the secreting portion by climbing up the ladder of the blood supply so to speak of the nephrogenic substance. The numerous blood vessels drop off and enlarge as the pelvis of the kidney ascends to its higher position and the secreting substance arranges itself over it and forms a capsule. The two mesothelial bodies may touch each other and become fused developing the horse shoe kidney or various attachments, 90 per cent of the horse shoe kidneys being fused at the lower pole. Some of the mesothelial or secreting portion of the kidney may not become connected with the collecting portion and may then retain its embryonic type forming a mesothelial rest from which may develop so called "hypernephroma" or more correctly mesothelioma of the kidney (Wilson 12). In other cases a failure of connection between the secreting portion with the collecting cavity and continuance of secretion without elimination form a congenital cystic kidney, usually double.

Wherever the kidney stops in the process of union of collecting and secreting portions its renal artery develops from the major supplying it at the time. As growth continues, the delicate vascular plexus outside the aorta disappears and the renal artery comes directly from the aorta, but owing to change in position it may come from a lower position on the aorta the sacral artery or from the common iliac. The malposition of the kidney is not so serious if it can but carry on its function but malposition may lead to injury. Excessive mobility is not a disease unless the renal function is interfered with or

the kidney in its movements disturbs some other organ, thus the movable right kidney may disturb a diseased appendix, the appendix however, being the primary offender. Mobility may interfere with urinary delivery by linking the ureter over a band of connective tissue or an anomalous artery which occasionally is seen connecting the lower pole of the kidney with the aorta, one of the original mesothelial vessels which failed to disappear. One kidney may be missing from a failure of development of the mesothelium - the secreting structure. Three or four kidneys may be present with three or four complete ureters or partial ureters. Splitting the collecting portion at the wolffian duct causes double ureters and fused or separated double kidneys on one or both sides. The division of the pelvis into several tubes connecting with one or two ureters is normal in the otter and beaver.

Occlusion and constriction of the urethra occasions various forms of maldevelopment in the male known as hypospadias and epispadias with terminology according to the extent and character of the cleft and the location of the external opening of the urethra. Slight malformations of the terminal portion of the urethra are not uncommon. Ectrophy of the bladder hypospadias and similar deformities are undoubtedly caused in a manner similar to spina bifida by secretion at an early period the blockage of exit causing a like separation of bone from interposed tissue and in ectrophy of the bladder preventing the formation of the pubic arch. Persistence of allantois with but partial development of the urachus causing a secondary bladder or cyst between the umbilicus and the normal bladder, is occasionally seen. During this time the cloaca is being divided by a partition into rectum and bladder and the proctoderm forming the anal depression should join the lower rectum. The latter process sometimes fails of completion the anus remains imperforate or the rectum is connected with the bladder of the male or the genital passage of the female through the cloacal connection.

From the paired manner of its origin, the uterus may fail of development into a single

body, each half remaining a separate organ or becoming partially fused and connected with its ovary and tube. The genital passage also may be double or single in association with such deformity, all of which conditions are normal in various vertebrates. There may be absence or atresia of the genital passage causing retained secretions within the distended uterus. Rarely all the genital structures except those connected with the ectoderm may be missing in the female. In the male the generative glands may be missing on one or both sides. They may remain within the abdomen or may be arrested at any point in the canal during their descent. The gubernaculum is probably not an active structure but merely steadies the generative glands while the body and limbs grow away from them.

In the caudal region are developed higher forms of dermoids than those of inclusion of skin. Such tumors have bone and tooth formation with hair and skin and are considered to have arisen from blastomeres by some investigators, from fertilized polar bodies or fertilized but imperfectly developed ova included within a normal one by others. There are also the theory of totipotent cells, and Shattuck's (13) theory that ovarian dermoids arise from a transmission of the fertilization to foetal cells in the developing ovary of the embryo.

In its early development the large bowel lies wholly on the left side of the spine and rotates around the superior mesenteric artery as an axis, the caecum at the third month being under the stomach later under the liver, and finally to the right iliac fossa. The surgical importance of this is that all the important blood vessels and nerves are on the inner leaf of the mesentery, the outer can be freely divided. All of the large bowel may remain on the left side of the spine through failure of rotation or the caecum by partial rotation may

come to rest at any position between the right iliac fossa and its place of origin. This is of importance when appendicitis occurs in such conditions. Because of the late descent of the caecum foetal membranes develop over it and about the ileocaecal valve. Rotation may involve the mesentery of the small bowel causing extensive strangulation as shown by Keith (14).

Persistence or failure of absorption of the union of the bowel with the cord as developed from the yolk-sac causes the various forms of Meckel's diverticulum. When adherent these diverticula are a source of danger because of their liability to cause intestinal obstruction from loops of bowel becoming strangulated beneath them.

REFERENCES

1. GILBERT SAINT-HILAIRE. Sur la vertebre La Revue Encyclopedique 1925. Quoted by Gaskell loc cit.
2. BATESON W. The ancestry of the chordata. Quart. J. Microsc. 1886 n.s. xxi 515-571.
3. GASKELL W. H. The Origin of Vertebrates. London 1905.
4. HECHT, D. O. A teratoma of the hypophysis. J. Am. Med. Ass. 1909 lxxi 1001.
5. CUSHING W. The Pituitary Body and its Disorders. Philadelphia 1912 p. 289.
6. SPERMANN H. Experimentelle Erzeugung zweier offener Embryonen. Sitzungs- u. d. phys. med. Gesellschaft zu Würzburg 1900.
7. STOCKARD C. R. The development of artificially produced Cyclopean fish. The magnesium embryo. J. Exper. Zool. 1909 vi 285.
8. MALL T. P. A study of the causes underlying the origin of human monsters. J. of Morphol. 1908 xix 3.
9. MOORE J. I. Spina bifida with a report of three hundred and eighty five cases treated by excision. Surg. Gynec. & Obst. 1902 i 11.
10. JONES R. Brit. Med. J. 1891 i 173 quoted by Sever loc cit.
11. SILLER J. W. Spina bifida occulta. Boston VI & S. J. 1909 cli 385.
12. WILSON L. B. A comparative study of the histology of the so called hypernephromata and the embryology of the nephridia and adrenal tissues. J. Med. Research 1911 xxi 73.
13. SHATTUCK S. G. Ovarian Teratoma. Lancet Lond. 1905 i 479.
14. KEITH I. Lancet Lond. 1914 ii 362.

THE DENTAL PATH ITS IMPORTANCE AS AN AVENUE TO INFECTION¹

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IN order to give this paper the greatest potential value possible to those interested in preventive medicine, I shall take the liberty of discussing only those types of infection which are most common not attempting to deal either with the rare infections or those now well understood, of which diphtheria is an example. It is indeed true that the mouth by reason of its size and function is probably the host at one time or another of almost every type of bacterial growth. The great majority of these growths however are visitors and not permanent inhabitants. It is the permanent inhabitants that are found in all mouths which interest us most and of these permanent inhabitants there is not one possessing such varied possibilities for disease as the streptococcus group and to it we will devote most of our attention. I wish to state clearly in the beginning that in discussing the varied activities of the streptococci I am well aware that I am not bringing new material regarding the activity of this organism. We all know that most of the lesions in different parts of the body produced by the streptococci have been studied in detail by many observers. I do wish however to make the point that while Rosenow, Klotz, Poynton and Payne and many others have worked with the streptococcus they have wrought without particular reference to the dental avenues of infection, and it was not until the work of Goadby published in 1912 in the rheumatism number of the *London Practitioner*, that particular reference to the tooth avenue of infection received systematic or detailed study in the English language. Goadby had in the years 1910, 1911 and 1912 carried on a series of studies by which he was able to produce experimental rheumatism in rabbits and

by the elimination of primary foci in the dental tract and the use of vaccines to supplement elimination, he was able to secure the recovery of three severe cases of arthritis deformans. To him therefore, I think must be given the credit for publishing the first observations on the relation of dental infection to that form of rheumatism.

If there be anything of marked value in this paper which may be of future use it will be in the fact that it offers definite and positive proof that the so called dental path of infection hitherto little appreciated is shown to be important and that organisms taken from the dental path have produced in animals almost all of the forms of lesion hitherto described, to wit lesions of the heart muscle and endocardium lesions of the kidney, focal and diffuse lesions of the adventitia of the blood vessels and lesions of joints and muscles. The evidence of Poynton and Payne (1) gained by creating an experimental arthritis in the eye of a rabbit by introducing streptococci in the circulation of the animal, together with the positive clinical results gained by the treatment of our twenty cases of arthritis enables us to place arthritis in this category also.

Before proceeding to further discussion of infections I wish to speak of the dental tract itself. We have in the dental tract the masticating mechanism originating in the epithelium of the mucous membrane budding and projecting from it into the tissues to later become inclosed by bony walls which grow and finally almost envelope it. Its direction of growth in the first instance is downward and into the tissues the tooth later bursting the very mucous membrane from which it originated (Figs 1, 2, 3). The mucous membrane is designed to protect the

¹ Read before the Clinical Congress of Surgeons of North America, Boston, October 30, 1911.



Fig. 1 Pathological condition showing the beginning of tooth formation T



Fig. 2 Slightly more advanced



Fig. 3 Shows the tooth crown partially formed containing a large pulp

tissues blood stream, and lymphatics from infection. The union of the mucous membrane to tooth structure is always after the eruption of a tooth imperfect and capable of admitting infection. It is a notable fact that the dental structure has no protecting device, save its coat of enamel. If this be in any way imperfect there seems to be no anti bodies or protecting leucocytes in the saliva to save it from the disintegrating effect of bacterial action. Unless aid be given by thorough cleansing of tooth surfaces the integrity of the tooth is sooner or later destroyed by acid forming microorganisms

which make its surface their home and later enter into its structure. How great a site for bacteria the tooth surface is can only be appreciated by the use of some method of staining bacterial masses *in situ*. If in the study of mouth infections particularly those about the teeth the observer will use a disclosing solution as recommended by Skinner, freely applied to the tooth's surface he will bring to view macroscopically masses of living bacteria which Kligler (2) has shown to contain twenty to six hundred million to the milligramme (Fig. 4). These will be found on cultural and microscopic examination to count among their numbers the streptococcus the various staphylococci, the



Fig. 4 Showing bacteria stain in mass on the teeth of a child. These teeth without discoloring stain are white



Fig. 5 Normal human gum showing bottom of a crevice poorly protected by epithelium

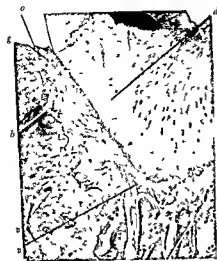


Fig 6 Showing vessel extending almost to the gingival crevice and leading into the peridental membrane. *c* Gum edge, *a* opening into vessels of peridental membrane, *d* dentine, *b* bone, *v* network of vessels.

pneumococcus the spirochete macrodentium and microdentium generally, and always the fusiform bacillus. In addition to these already mentioned are two protozoa the *entamoeba buccalis* and the *trichomonas*



Fig 7 Showing calculus on the tooth's neck and pus flowing from well marked pyorrhea pockets in the mouth of a man who now has a multiple arthritis

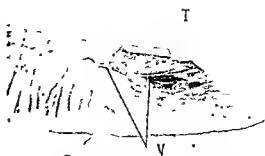


Fig 8 Showing human pyorrhea pocket. Note the great mass of plasma cells on the ulcerating surface of the pocket. *T* tooth, *v*, vessel.

intestinalis. It will be seen from a study of the flora of the tooth surface that this flora always has the power to infect the soft tissues about it. Next we will show the capability of the structures about the tooth to receive infection from it.

Our next point of interest therefore is the gingival crevice or gum marginal crevice in total length about thirty inches protected externally by a tough pavement epithelium but containing almost no epithelial protection (Fig 5) at its point of union with the tooth structure. This lack of protection is well illustrated by recent preparations of Henrici originally made to demonstrate the vascularity of (Fig 6) the tissues immediately surrounding the teeth but showing as well the lack of mucous membrane protection at the gingival crevice. It will be seen by a study of these pictures that motile organisms growing on the tooth's surface or organisms which reproduce rapidly may readily pass into the delicate openings in the bottom of this crevice thus gaining direct access to venules and perivascular lymph spaces in these structures with nothing to hinder their transfer to the deeper tissues by the lymph and blood streams. This process is in the majority of individuals greatly aided by the formation of calculus (Fig 7) on the root surface or at the gingival margin. When once an organism enters the tissue at this point its future progress into the tissues is hastened by the vast power of mastication the sum of masticatory pressures amounting to about one ton per day in the average individ



Fig. 9

Fig. 9 Shows experimental myocarbitis in a rabbit. Note the thrombs and giant cells of the type described by Aschoff.

Fig. 10

Fig. 10 Shows an identical type of myocarbitis in a human child that of a girl fourteen years of age who

Fig. 11

died after repeated attacks of acute rheumatic fever with chorea.

Fig. 11 Shows acute myocarbitis prepared from material taken from a dental abscess that of a man who was suffering an acute arthritis whose eye is shown in Fig. 12.

and the masticatory force depresses the tooth in its joint or socket and the elasticity of the tissues causes rebound when the power of occlusion is released. The tooth therefore plays the part of a piston during mastication with the average movement of a sixteenth of an inch. It cannot be doubted that this movement aids the ingress of organisms to the underlying tissues through the unprotected areas of the gum crevice. The masses of bacteria growing on the tooth's surface and in the gingival crevice even if they do not always gain access to the tissues in the way just described produce enzymes and irritating toxins which inflame the gum margin resulting in edema and further favoring bacterial development in this thin wedge of tissue. This brings about as a rule destruction of the few cells lining the crevice causing ulceration (Fig. 8) paving a way presently to pyorrhea and providing the potential for periodontal inflammations such as abscess, etc. The writer has record of one hundred and fifty teeth which were absolutely sound as far as the enamel was concerned the pulps of which had been destroyed by infection and we quite often find teeth the pulps of which are undergoing

profound inflammation without having been exposed by decay. The most plausible explanation for this is that this richly vascular tissue surrounding the tooth has received infective organisms from the tooth's surface which have been conveyed through the vessels to the pulp as we have been able in many instances to obtain microorganisms in these newly opened pulp chambers. It is not surprising therefore that we have ab-



Fig. 12 Shows eyes of patient with severe acute arthritis and a dental abscess.



Fig. 13 Note hemorrhage at the base of pupillary muscles *h*

cesses in the tissues about living teeth as well as about dead or pulpless teeth because the conditions favor the planting of infection in this locality. It may be that a dead tooth provides a *locus minoris resistentiae* (3) in its neighborhood, but to accept this as a principle governing the formation of abscess about all dead teeth or even in the majority of instances I regard as premature and likely to lead to a wrong attitude on the part of dentists and physicians concerning a very vital subject.

In the study of a series of acute dental abscesses during the past year we find the staphylococcus the active organism, while in the study of material taken from 250 chronic abscesses of the cystic or granulomatous type the streptococcus viridans is found to be the predominating organism. All teeth whose pulps have become exposed through the medium of caries are infected and mastica-



Fig. 14 Heart muscle fibers destroyed by salivary streptococcus.



Fig. 16 Vegetative endocarditis in a rabbit experimentally produced by inoculation with streptococci obtained from a dental abscess

tion into the pulp chambers of such teeth insures infection of the para apical tissue. Teeth which are heavily coated with bacterial masses particularly the protected surfaces in the proximal spaces, are capable of and do plant infection in the tissues contiguous to them.

A further evidence of how readily this may occur is shown by a series of recent experiments with oxygen under compression which was discharged into the gum crevice from a blunt needle not thrusting the needle deep into the crevice but only half way toward the bottom. The oxygen will enter and be seen to lift the tissues back toward the palate and many times bubbling out of the tissues from the gum margin of a tooth a half or three quarters of an inch removed from the



Fig. 15 Shows vegetations on the mitral valve of a patient in our series who had multiple dental abscesses



Fig. 17 (at left) Section of the aorta of the girl whose myocardium is shown in Fig. 10

Fig. 18 A similar but more extensive lesion in the adventitia of the aorta of a rabbit inoculated with streptococcus viridans from a dental abscess

point of entrance. This shows the extreme looseness of attachment of the peridental membrane and the ease of its infection. If pyorrhœa obtains for some time, say long enough to produce an average depth of ulcerating surface of a quarter of an inch about each of the teeth, we then have an ulcerating surface of seven and one-half square inches. If the average depth of pocket was only one-eighth of an inch, we have an ulcer equivalent to three and one-fourth square inches. Compare this ulcerating surface infected with all sorts of organisms to the greatest possibility of the tonsils with eight to sixteen crypts in each, and you have some idea of the relative importance of the dental tract in the planting of general infection.

Ulrich (4) in his paper entitled "Some Medical Aspects of Dental Disease" teaches that dental abscesses originate in the blood stream but does not tell us how the infection enters the blood claiming that the lack of vital pulp is the determining factor in the locating of abscess. As a matter of fact, hundreds of pulpless teeth are in use that are not abscessed. It is needless to state that septic root canals are responsible for many dental abscesses and it is true that modern

methods have made possible the safe retention of such teeth where the individual is otherwise in good health, but on account of the exact technique necessary to gain and maintain asepsis in such teeth, they should always be kept under surveillance by radiographic methods. Our own conclusions and belief regarding the infections that occur in the dental tract are that they usually enter by and through the gum crevice, veins, perivascular lymph-spaces and root-canals when opened by ulceration, decay, or careless operative procedure.

Two years ago the scientific foundation and research commission of the National Dental Association placed in our hands a sum of money (\$2,000 per year), which we determined to use to gather evidence of the relationships that mouth infection bear to metastatic infection of other parts of the body. This research has been carried on in the laboratories of the school of medicine and has been assisted during the past year by an additional grant of funds from the research department of the graduate school. The laboratory procedures have been carried forward by Doctor Henrici of the school of medicine. Our endeavor has been to approve or disapprove, as the case might be, the



Fig. 19 (at left) Multiple abscesses in the cortex of a rabbit's kidney induced by material originally obtained from a dental abscess in the mouth of a man whose hands and feet are shown in Figs. 21 and 22.

Fig. 20 Bacterial emboli and the capillaries of the cortex have surrounding areas of inflammatory infiltration which show both pus-cells and lymphocytes.

clinical evidence tending to connect infections about the teeth with distant secondary infections of other parts of the body. To that end, we have used bacterial cultures obtained from both pyorrhea pockets and apical abscesses of individuals suffering secondary infection. From our first series of cases resident in the university hospital we were able to produce lesions of heart muscle and endocardium, as illustrated by the three accompanying photographs. Figure 9 shows chronic myocarditis in the heart muscle of a rabbit which died sixteen days after an injection of streptococci from Case 55. The section shows an area of fibrosis with several giant cells. This is myocarditis of the type described by Aschoff, generally considered to be specifically rheumatic in nature (Fig. 10).

Case 55, from which we obtained the culture which produced the experimental myocarditis shown in Fig. 9, was that of a married woman of forty years of age, of German descent, by occupation a housewife, weight 150 pounds, of good habits, with no trace of familial or venereal disease. When she came under our care, January 18, 1914, she had pyorrhea alveolaris, congestion of the lung bases, cardiac hypertrophy and dilatation, acute hypertrophy and dilatation, mitral incomp-

petency and stenosis, acute arthritis, with swollen joints. The culture material was obtained from pyorrhea pockets and extracted roots. Its effect on the heart muscle of a rabbit was profound as you note. The result of treatment in this case was quite satisfactory.

Figure 11 shows an area of acute infection involving seven or eight heart muscle fibers in the heart of a rabbit which died forty-eight hours after an injection of streptococci obtained from Case 60, that of a man who was suffering an acute infection evidently the result of a dental abscess involving the left antrum. The infection presented posterior synechia and a marked congestion accompanied by great pain (Fig. 12). Extraction of the tooth and curettage of the sockets resulted in a rapid reduction in the inflammation of the eye and the material obtained from the tooth socket developed not only the acute inflammation shown in this picture but also a hemorrhage into the mitral cusp of the rabbit's heart shown in Fig. 13. Here we have chronic infection of the heart muscle with repair by scar tissue, acute focal infection of the heart muscle and a hemorrhage under the endocardium produced by the streptococcus viridans from this single source, a dental abscess.

We have since produced many such lesions with the streptococcus ordinarily found in the saliva and I will show next a section of heart muscle in a rabbit which has received an injection of streptococci obtained not from



Fig. 21 Hands of a man from whose dental abscesses we took the material originally to produce the lesions in Figs. 19 and 20



Fig. 22 Feet of man from whose dental abscesses material was taken to produce the lesions in Figs. 19 and 20

a lesion but from saliva (Fig. 14. Note destruction of muscle-fibers)

Besides lesions of the heart-muscle, lesions of the heart valves are most commonly associated with rheumatism. The relationship of the streptococcus viridans to endocarditis has been produced in rabbits by inoculation with streptococci repeatedly, especially by Poynton and Payne and by Rosenow. Figure 15 shows vegetations on the mitral valve of a patient in our series who had multiple dental abscesses. Figure 16 shows vegetative endocarditis in a rabbit experimentally produced by inoculation with streptococci obtained from a dental abscess.

Lesions of the blood vessels accompanying rheumatism were noted in 1828 by Trouseau,¹ and also by Hanot,² who supported his observations by autopsy.

"Roche and Burnand (5) reported the case of a man, age 30, who had long suffered from rheumatism. His first attack had occurred seventeen years previously and since then he had suffered recurrent attacks, in each of which the heart was more or less involved. Recently, his heart failed to compensate for the severe lesions of the mitral and aortic valves. When seen by the author he was cyanosed and showed edema of the lower extremities. He had continuous fever of moderate degree. After some weeks his temperature suddenly went up, and he complained of pain in the left arm which continued to increase. In three days the radial pulse disappeared gradually a small

radial pulse was again obtained. After some weeks a mass appeared close to the upper humerus which was quite painful to touch. Later on, the patient developed a similar lesion in the left arm.

"Much other material may be found bearing on this same question of vascular lesions from Leger (6) and Hanot (7) who described rheumatic aortitis, while Rabe (8) has studied rheumatic disease in the coronary artery. The latter described two principal lesions, one consisting of a proliferating endarteritis, the other of a diffuse mesarteritis. It is probable that the other peripheral arteries react in a manner similar to but milder than in the coronary arteries (9)."

We have made the above citations and show the following arterial lesion pictures to suggest the fallacy of the old established belief that all aortic arch lesions are specific when it is quite possible that some may also be of streptococcal origin. The relationship of rheumatism to diseases of the aortic arch has been recently studied by Klotz (9), who finds constantly a characteristic lesion of the adventitia. Such a lesion is shown in Fig. 17, which is a section of the aorta of the girl whose myocardium is shown in Fig. 10. The section shows subintimal foci of infiltration about the vaso-vasorum of the adventitia. Figure 18 shows a similar but more extensive lesion in the adventitia of the aorta of a rabbit inoculated with streptococcus viridans from a dental abscess.

In a recent series of thirty animals inoculated with ordinary salivary streptococci by us, we have found a number of animals whose

¹ *Archiv gén. de med.* 1828 xvi 409

² *Presse med. Par.* 1866 i p. 622

joints are filled with pus-containing streptococcus viridans. They also exhibit heart-muscle infection, and well formed vegetations on heart valves, focal infections of the kidney as well as diffused kidney infection. If ordinary salivary streptococci will produce these lesions just as will streptococci taken from the dental abscess or the pyorrhœa pocket, it would seem well worth while to give greater attention to closing the door to this infection by treatment directed toward the prevention and cure of pyorrhœa and dental abscess and the maintenance of health in the whole dental tract.

In addition to the lesions already shown which involve heart-muscle, endocardium, and vessels, we desire to show you a picture of a focal and diffused infection of the kidneys produced from material taken from a dental abscess from Case 59, which produced two types of streptococci, one growing gray on blood agar, the other growing green. Both strains were isolated in pure culture. In massive doses, broth culture produced death in twenty-four hours; in smaller doses (8 cm.), death occurred in forty-eight hours. The green strain produced hæmorrhage into the mitral cusp of the rabbit's heart, the other strain produced minute multiple abscesses throughout the kidney cortex. The streptococci were re-obtained in pure culture from the blood of both rabbits, and, after twenty-four hours' incubation, were injected into two new rabbits in 5 ccm doses. Both of these rabbits died within forty-eight hours. The autopsy revealed no lesions save for a large number of miliary abscesses in the cortex of the kidneys (fig 19). The streptococci were again recovered in pure culture from the heart's blood and from the kidneys and these are the kidneys shown in microscopic section (Fig 20). They show bacterial emboli, and the capillaries of the cortex have surrounding areas of inflammatory infiltration which exhibit both polymorphonuclears and lymphocytes. There was a pronounced necrosis in the breast muscles of a pigeon inoculated with this strain which died within twenty-four hours. Our comment on this strain is that we have apparently an organism belonging to the streptococcus

viridans class possessing a high degree of virulence which is indicated by the rapidity with which it causes death in animals and by the fact that it calls out pus cells in the infected animals. We note also that this strain shows a marked affinity for kidneys as there were no joint lesions and no heart lesions except a valve hæmorrhage.

CASE 59 The patient from whose dental abscess the first culture was obtained is forty years of age and has suffered from arthritis deformans for twenty years. This has resulted in the partial disarticulation of his phalangeal joints of both hands and feet as shown by the accompanying pictures (Figs 21 and 22).

While we have not done systematic research with the other constant bacterial inhabitants of the mouth we have dealt practically with many cases of secondary infection in which the primary lesion commenced in the dental arches and resulted in multiple abscesses in different parts of the body.

A recent case that of a youth of sixteen developed an acute primary abscess in a lower central. This resulted in a general pyæmia producing abscesses in different parts of the body, the most pronounced of which were in the gluteal muscles. The primary effect of the infection in the jaws was to destroy the whole body of the lower jaw from the ramus forward the whole body of which has been removed gradually, retaining only enough of it to act as a splint while the new body has developed.

Cases of this type are fairly common particularly in the mouths of people who are careless in the care of their teeth.

A second case of the acute staphylococcal type was that of a physician with a primary abscess about a lower molar which resulted in the loss of one inch and a half of bone and the destruction of the facial nerve on the right side.

A third case of similar nature, a primary staphylococcal abscess about the lower third molar in the mouth of a young Swedish girl, resulted in the loss of the angle of the jaw and secondary metastatic abscesses in other parts of the body.

In addition to these cases we have on record the experience gained in the care of six individuals who died as a result of primary mouth infections spreading to other parts of the body in which cases autopsy disclosed only the mouth as a primary focus. One of these deaths was due to a fusiform bacillus

infection originating around two central incisors. The primary culture and smear disclosed enormous numbers of fusiform bacilli in this slough and a blood culture taken by Doctor Larson disclosed a general fusiform bacillus infection in the blood stream. Our experience with the damaging effects of the diplococcus as a mouth inhabitant is limited to one case in which the primary infection around a bicuspid yielded the diplococcus pneumonia in large numbers. Removal was coincident with a pneumonia involving the lower lobes of each lung. The patient made an uneventful recovery from the pneumonia two years ago last winter only to die of a second pneumonia January, 1914. The infected socket had been the host of this stinking abscess for some five years prior to its removal. Surely the responsibilities of those who have to do with the prevention of the development and growth

of streptococci in the mouths of people are of a grave nature indeed. Bacteria grow on the mucous membranes but sparsely as compared to the enormous numbers, particularly of streptococci, which grow on tooth surfaces and in gum crevices, and the further fact that we have a direct continuity of the tooth's surface with the imperfectly protected gingival crevice makes the tooth's surface, when loaded with organisms, a factor worthy of the serious consideration of those who deal with human life.

REFERENCES

- 1 Research on Rheumatism, p. 213
- 2 J. Allied Soc., 1915, September
- 3 Ulrich Dental Review, 1914
- 4 Dental Review, 1914
- 5 Roche and Burnand, Semaine méd., 1908, xxviii, 145
- 6 Leger, Thèse de doct., Paris, 1877
- 7 Hanot, Presse méd., Par., 1896, I, 649
- 8 Rabe, Presse méd., Par., 1902, II, 927
- 9 Quoted from Klotz, J. Path. & Bacteriol., 1913, xviii
- 10 Klotz, J. of Path. & Bacteriol., 1913, xviii

THE RELATION OF AMŒBIASIS TO PYORRHŒA ALVEOLARIS¹

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THE facts we wish to present are not the result of a study of pyorrhœa alveolaris in its rôle as a source of general infection but concern the presence of certain protozoan parasites in the mouth and alimentary tract in persons afflicted with this disease.

Amœbæ have been known for the past 65 years to exist in the mouth. Neven and Lemire (1) give as the synonyms for amœba gingivalis (Gros 1849) the terms amœba buccalis (Steinberg 1862), amœba dentalis (Grasse 1879) and amœba kartulis (Doflein 1901), thus considering that these are all the same organism and, also, that they are non-pathogenic. In 1904, Prowazek (2) described entamœba buccalis and considered it non-pathogenic.

In Braun's (3) *Animal Parasites of Man* the subject is treated in practically the same way. As regards the finding of amœbæ in the pus of abscesses in the mouth, Braun

says "Doflein conjectures that it was a question of dysenteric amœbæ." This statement is interesting and will later be considered in detail.

LeWald's (4) attention was first called to amœbæ in the mouths of Philipinos and later in this country he found amœbæ in the mouths of 71 out of 100 persons on the first examination. He did not make a complete study of their morphology, but considered them identical with gingivalis or buccalis and he suggested the name amœba oralis hominis indicating its constant presence in man.

The recent increased interest in the subject has been stimulated by articles by Smith and Barrett (5) and by Bass and Johns (6) independently suggesting that the entamœba buccalis is the cause of that common disease pyorrhœa alveolaris. Smith and Barrett found amœbæ in all of 46 cases, and found none in seven mouths that were normal.

¹ Read before the Clinical Congress of Surgeons of North America, Boston, October 25-30, 1913.



Fig 1a *Entamoeba histolytica* warm stage observation



Fig 1b *Entamoeba histolytica*, warm stage observation

Bass and Johns base their conclusions on the positive findings in more than 300 gross lesions. They state also that there are many other factors to be considered in the etiology of the disease, such as "picking the teeth, cleaning with hard brushes, floss, rubbers, and the effect of hard particles of food between the teeth making pressure on the gums, tartar on the teeth, ill fitting crowns, etc."

A very complete study of the etiologic factors in the disease has been recently reported by Price (7). This work was carried on for the Scientific Foundation and Research Commission of the National Dental Association. The article is exceedingly fair and weighs all evidence regarding the significance of amœbe in the mouth. He suggests that judgment be withheld until further researches shall have established sufficient data. We quote him as follows:

The successful production of the lesions of pyorrhea alveolaris by inoculation with *Entamoeba* according to Koch's laws

Or, the successful production of the lesions by inoculation with some other organism or organisms, or by some other means

Or, the demonstration that the *Entamoeba* of the mouth are non pathogenic and are incidental or helpful inhabitants of the oral cavity as scavengers, not only harmless of themselves, but not producing either toxins or harmful enzymes

The establishment of the rôle of emetin including a close differentiation between its amœbicidal and its bactericidal actions

The establishment of the precise local tissue changes involved in the development of the lesion of pyorrhea alveolaris and of the successive processes constituting its repair

The establishment of the rôle of pyorrhea alveolaris pockets as culturing places for pathogenic microorganisms, as those of the streptococcus-pneumococcus group which from this lesion as a primary focus affect other organs and tissues of the body and the establishment of the symbiotic effects of the organisms on each other

Granting that *Entamoeba* is the causative factor of pyorrhea alveolaris and that emetin hydrochlorid is a specific for it, why has no pyorrhea pocket, of the many cases treated by the authors, been more greatly modified in the way of repair than the more or less marked improvement of the following factors: the quantity of pus flowing, the relative quantity of microorganisms growing in the pockets and the general tonicity of the surrounding connective tissues, with practically no considerable change within several months of the bone lesion itself surrounding the tooth?

For several years at the Mayo Clinic we have been interested in finding amœba in mouths that showed disease. This work was not carried out systematically and was done purely incidentally in making stool examinations for intestinal parasites. Since January, 1915, however, the work has been conducted in a manner to make statistical study possible. One of us examined the mouths of patients coming for throat examination and 106 of these were selected for study. Pus about the teeth was drawn into a pipette, a cover-slip preparation made on a



Fig 2a *Entamoeba buccalis*, warm stage observation

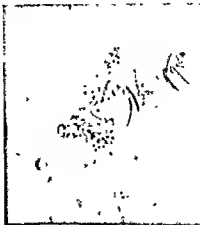


Fig 2b *Entamoeba buccalis* warm stage observation

slide and sent to the laboratory for examination. A search for the parasites was made on a warm stage using a 4 mm objective. Owing to the fact that there is usually so much pus, there is very little contrast in the field and it is more difficult to find them than is the case with amoebae in the stools. However, three or four minutes' search usually results in finding actively motile organisms, with a very clear ectoplasm and often with several red blood-cells ingested. Their size and morphology is very similar to *Entamoeba histolytica* found in stools of patients with amoebic dysentery. Besides the patients sent primarily to New for examination, a few of those who were having stool examinations were sent to him each morning for mouth examination. There were in all 221 of these patients, making a total of 327 in the series studied.

The cases have been classified into five groups. Pyorrhoea 0, 1, 2, 3, 4, denoting the degree of infection in the mouth that could be demonstrated by an ocular examination and by pressing on the gums to force out the pus. The Pyorrhoea 0 group included those in which no sign of pyorrhoea could be seen and no pus could be pressed from the margin of the gums. None of these cases showed any gingival irritation from poorly fitting crowns or fillings. Groups 1 to 4 were graded according to the gross amount of infection in the mouth and not on the degree of pyorrhoea about one

tooth or group of teeth. Group 1 indicates an early pyorrhoea involving possibly the lower central incisor or the molar teeth, while Group 4 includes cases with a very extensive pyorrhoea. Groups 2 and 3 were graded in their relative position in the classification, indicating the degree of infection in the mouth. The classification of the patients and the search for the parasites were entirely independent procedures on the part of the two observers, and the results compared only at the time of preparing this report.

Of the total 327 cases, 181 (55 per cent) showed amoebae in the mouth, all classified as *Entamoeba buccalis* (Prowazek). Of the cases in Group 0 (no pyorrhoea), numbering 58, there were 8 (14 per cent) with parasites (Table I). Amoebae were reported in 43+

TABLE I

Grade of Pyorrhoea	Total Number of Patients	Number with <i>Entamoeba buccalis</i>	Percentage
0	58	8	14—
1	51	22	43+
2	80	55	62+
3	83	63	71+
4	41	33	80+
Total	327	181	55+

per cent of Group 1 (slight pyorrhoea), in 62 per cent of Group 2 (moderate pyorrhoea), in 71+ per cent of Group 3 (advanced pyorrhoea); and 80+ per cent of Group 4 (severe pyorrhoea). The relative increase in percentage as the severity of the gross appearance

Fig 3a *Entamoeba histolytica* stained with iron hemotoxylinFig 3b *Entamoeba histolytica*, stained with iron hemotoxylin

of infection increased is most striking. The significance of this can be interpreted in various ways. By some it may be taken as a direct indication of the specific etiologic rôle of *entamoeba buccalis* in pyorrhea alveolaris. We must not overlook, however, the 14 per cent positive findings in the group with mouths apparently free from infection. Another interpretation of the facts is that there was an increase in percentage of cases directly proportional to the degree of pathologic change in the mouth most suitable for their existence.

Many observers have noted the similarity between *entamoeba buccalis* and *entamoeba histolytica*. Smith and Barrett (8) state "From a purely morphological standpoint we are unable to differentiate the organism which we believe to represent the vast majority of oral *entamoeba* and to occur in an extremely large number of persons not merely in the tropics but throughout the world, from *entamoeba histolytica* Schaudinn. We are unwilling to make any assertion which involves biological identity in full, merely asserting that the morphological similarity is so close that we feel unable to make a distinction from microscopic observation alone. . . . Even if this suggestion be refused, the writers feel that there is need of a more

easily demonstrable differentiation, and believe that more than merely morphological studies are requisite to prove dual specificity."

If these organisms are identical, a large percentage of patients with *amoeba* in the mouth should show *amoeba* in the stools, especially if they have chronic diarrhea. It was with the idea of shedding some light on the relationship between the two types of *amoeba* that patients with chronic diarrhea and whose stools were examined first for *amoeba*, also were examined second for pyorrhea, and third for the *entamoeba buccalis*. The results are given in Table II.

TABLE II

	Total number of cases	Percentage
Total number <i>entamoeba buccalis</i>	327	
<i>Entamoeba histolytica</i>	131	55
<i>Entamoeba buccalis</i>	73	31
Other cases	254	42+
<i>Entamoeba buccalis</i>	254	59+
<i>Entamoeba buccalis</i> (patients sent for stool examinations)	103	
<i>Entamoeba histolytica</i>	31	31

It will be seen from the above table that there were 73 patients with *amoeba* in the stools, and 254 in which none were found. One hundred six of the 254 were non diarrheic patients. These had no stool-exam-

¹ The universality of *amoebic dysentery* is established. A report on the geographic distribution of *amoebiasis* is in process of preparation.

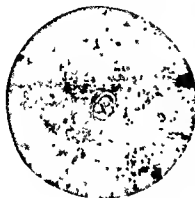


Fig. 4a *Entamoeba buccalis* stained with iron haematoxylin



Fig. 4b *Entamoeba buccalis* stained with iron haematoxylin

inations as there were no symptoms that made such an examination necessary. Of the 73 patients (stools containing amœbæ) 31 (42 per cent) had *entamoeba buccalis*, while of the 254 patients (no amœbæ were found in the stools) 150 (59 per cent) were infected with these parasites in the mouth. In other words, there is a smaller percentage of patients with amœbæ in their stools that have *entamoeba buccalis* in their mouths than in the ordinary run of cases.

Still another consideration of this group of cases brings out the fact that of the 221 diarrhœic patients sent for mouth examination, 103 had *entamoeba buccalis* in their mouths, while only 31 (31 per cent) of these (all patients with symptoms sufficient to warrant a search for intestinal parasites) had *entamoeba histolytica*. These 221 patients were classified according to the condition of the mouth, as follows: 42 patients with no pyorrhœa, and 4 of this number with *entamoeba buccalis* in their mouths, 40 with Grade 1 pyorrhœa, 14 with *entamoeba buccalis*, 59 with Grade 2 pyorrhœa, 29 of whom had *entamoeba buccalis*, 57 with Grade 3 pyorrhœa, 38 with *entamoeba buccalis*, and 23 of the most severe type, or Grade 4, of which number 18 had *entamoeba buccalis* in their mouths. As mentioned before, of the total number having amœbæ in their mouths only 31 per cent had amœbæ in their stools.

Because of its amœbicidal properties, ipecac or its alkaloids has been suggested as a suitable drug for the treatment of pyorrhœa

alveolaris. In fact, so widespread has become its use that it is now spoken of even by the laity as "the cure for pyorrhœa" and its use demanded. Our experience with the drug is limited, but enlightening.

In our first series, thirty-three patients of varying degree of pyorrhœa were treated with emetin. In all where indicated roentgenographs were taken and teeth showing apical abscesses or teeth about which the disease seemed too far advanced to save were removed before treatment was commenced.

The *entamoeba buccalis* was demonstrated before treatment was instituted. Emetin was administered either hypodermically in $\frac{1}{2}$ to $\frac{3}{4}$ gr doses of Lilly's ampules, or Alcresta tablets (Lilly) two to three times daily. In every instance the smears failed to show the presence of the *entamoeba* within four to seven days. On the other hand, we did not observe the marked improvement locally that has been reported from many sources. Some of the patients felt much better generally, but we question if the therapeutic action of emetin does not owe its value to some general effect which has not as yet been demonstrated experimentally by the pharmacologist or recognized by the clinician.

The patients were then sent to have thorough dental surgical treatment without further medical treatment and after this an improvement was noticed.

Very frequently when no amœbæ were found after dental treatment, by waiting four or five days the parasites could again be

demonstrated. These would disappear after a few days of treatment, but only temporarily.

The rather unsatisfactory results of this method of treatment suggested that we try the emetin on a group of patients that already had had repeated and thorough dental treatment by competent dentists both locally and throughout the state. Twenty of these patients were examined by local dentists and thought suitable to test the value of emetin, since frequent and thorough instrumentation had failed to cure their pyorrhœa. However, only eight of these could be induced to carry out the prescribed course of treatment. *Entamoeba buccalis* was demonstrated in all of them. They were given thorough emetin treatment and the condition of their mouths did not improve. One patient, still under observation, has had twenty-six injections of $\frac{3}{4}$ gr. doses of emetin in addition to thorough dental attention and there is no improvement. If emetin is the cure for pyorrhœa we believe the specific action should be seen in this manner of treatment.

Though there may seem to be some evidence to the effect that the *entamoeba buccalis* is a factor in Rigg's disease, yet we feel that Koch's postulates are the ultimate standard by which the specific cause of any infectious disease must be judged. We are thwarted at the outset by the fact that up to the present time parasitic amœbæ have never been cultivated. However, we thought that it might be possible to find lower animals susceptible to infection with *entamoeba buccalis* and we carefully examined for parasites the mouths of 18 dogs. Bodonides, a flagellate protozoa, were found in three, but in not a single instance were there amœbæ. Many of these were old dogs with discolored teeth. Two of this group of animals were selected and at the juncture of the gingival margin of a molar tooth, pus was injected from pyorrhœa cases containing amœbæ. One dog was inoculated with material from three different mouths and the other from two patients. After several weeks of observation neither animal showed any signs of pyorrhœa, nor could amœbæ be found.

Recently we have taken five old dogs and

made similar preliminary examinations for protozoa in the mouth, all of which were negative. With a periosteal elevator, pockets were then made about the lower molar teeth, producing considerable trauma. A few days later pyorrhœa pus containing amœbæ were placed in these pockets. These animals have also remained negative.

There are many technical difficulties to be considered in any attempt to produce the disease artificially. Dogs are animals with unusually clean mouths and may well be highly resistant to infection. We have also examined the mouths of two rhesus monkeys and found that their mouths are free from pyorrhœa and amœbæ. Pockets were made around the molar teeth, and pus from several sources containing amœbæ was injected. The result in this experiment was also negative.

We recognize the very just criticism that we have in no way disproved the possibility of *entamoeba buccalis* as the cause of pyorrhœa alveolaris. We do hold, however, that the burden of proof still lies with those who claim the pathogenicity of this organism and that there should be further attempts to produce the disease experimentally.

Sellards and Baetjer (9) have reported interesting results in the production of amœbic dysentery in cats by performing laparotomies and injecting amœbæ containing material directly into the cæcum. Following their technique, with the cooperation of Mann, we have injected five kittens with *entamoeba buccalis*. These animals have all remained healthy, at no time showing any signs of diarrhœa, while two control kittens injected with *entamoeba histolytica* developed typical amœbic dysentery with demonstrable organisms. Guinea pigs are highly susceptible to amœbic infections, but four of these animals injected with *entamoeba buccalis* showed no signs of dysentery. One died of peritonitis 48 hours after operation, but the other three are alive and normal.

At one time during our study of these cases we were very hopeful that the cause of pyorrhœa alveolaris had been found and the cure established. At present, our opinion based on statistical and experimental study may be expressed in the following conclusions

1. *Entamoeba buccalis* is found in at least 14 per cent of mouths free from gingival irritation, and in relatively increasing numbers in accordance with the degree of pyorrhea as we have classified them.

2. Clinically there is no parallelism between the presence of *entamoeba buccalis*, the parasite amoeba of the mouth, and *entamoeba histolytica* the cause of amoebic dysentery.

3. We believe that before the alkaloids of ipecac can be accepted as the cure of pyorrhea alveolaris it must be established that they actually destroy the amoebæ in the mouth thus removing the cause of the disease.

4. Our experiments, few as they are in number, with Sellard and Baetjer's technique of intracanal injection convince us that *entamoeba buccalis* and *entamoeba histolytica* are not the same organism. We also hold that before *entamoeba buccalis* is called the

cause of pyorrhea alveolaris its pathogenicity must be demonstrated by animal experimentation.

REFERENCES

1. NEVEU and LEMAIRE, M. Précis de parasitologie humaine. Paris: Rudeval, 1908, p. 182.
2. PROWSE, S. *Entamoeba Buccalis*. Arb. a. d. K. Gesdhisante, 1904, xv, 42. Quoted by Craig, C. F. in *Parasitic Amoebæ*. Philadelphia 1911.
3. BRAUN, M. The Animal Parasites of Man. New York, 1906, p. 37.
4. LEWALD, L. T. Personal communication on report published in Proc. N. Y. Path. Soc., 1907.
5. BARRETT, M. T. Clinical report upon amoebic pyorrhea. Dental Cosmos, 1914, lvi, 1345.
6. BISS, C. C., and JOHNS, T. M. Alveolodental Pyorrhea. Philadelphia, 1915, p. 167.
7. PRICE, W. A. Are *entamoeba* important factors in the etiology of pyorrhea alveolaris? J. Nat. Dental Ass., 1915, ii, 133.
8. SMITH, A. J., and BARRETT, M. J. The parasite of oral endamæbiasis *entamoeba gingivalis* (Gros). J. Parasitol., 1915, i, 259.
9. SELLARDS, A. W., and BAETJER, W. W. The recognition of atypical forms of intestinal amæbiasis. Bull. Johns Hopkins Hosp., 1915, xxvi, 43.

DEEP-SEATED ALVEOLAR INFECTIONS¹

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IN studying the dental path as an avenue of general infection it is of the utmost importance to disassociate what is known as pyorrhea alveolaris from either an ordinary alveolar abscess or its more insidious and dangerous type of an infected zone around the end of a root with no pus formation and no sinus, and known as a dental granuloma. The etiology of these two pathogenic conditions is so divergent that they must be considered from entirely different viewpoints. The fact that in both medical and dental gatherings they are discussed so frequently as though they be longed to the same type of infection is due to the lamentable weakness in the medical curriculum on oral topics, and in the dental curriculum on general pathology.

The dental student is woefully ignorant of everything pertaining to the body outside of the dental organs. Nevertheless he

treats pathogenic conditions that have the closest relationship with every important organ. The medical student is taught the anatomy, histology, physiology, and pathology of every part of the body except what may be termed the dental organs. The portal of entry to the digestive tract and the portal of entry for the great mass of pathogenic organisms remains a sealed book to the medical student instead of being viewed as one of the most important studies necessary for a proper understanding of infections. Stomatologists, who with a thorough medical education, however acquired, have made a special study of the dental organs, are the only men whose opinion on these topics should have any recognized value.

In the eyes of the stomatologist the recent work of Bass on this subject is so full of error as to command very little respect. Instead of pyorrhea alveolaris being so

¹ Read before the Clinical Congress of Surgeons of North America at Boston, October 25, 30, 1915.



Fig 1



Fig 3

common, it is very uncommon and only found after some form of malnutrition has proceeded far enough to destroy the immunity of this end organ tissue

Many cases of alveolar abscess are erroneously diagnosed as pyorrhea alveolaris. This grave error was much more common before the advent of roentgenology. It has been found that the toxæmia resulting from a dental granuloma is far greater than from a pyorrhœal discharge. Statistics show that while the death rate in infancy, adolescence, and early middle life has been steadily decreasing year by year, on the other hand from maturity to old age, until last year, the death rate from diseases of the heart blood vessels, kidneys, etc. has practically doubled in the United States in the past thirty years. Forty years ago the dentists in the United States did very little tampering with the pulp of a tooth. It was the rule to practice extraction as soon as there was pulp involvement.

During this period there was a remarkable advance in what may be termed the technical art of dentistry. Each step in this artistic and mechanical advance brought with it less respect, less fear, of the consequences of preserving in the jaws teeth in which the pulps were devitalized. The conscientious dentists felt that the acme of professional service had been reached when after the pulp had been removed the tooth remained in the jaw without giving any discomfort. Bacteriology twenty years ago had not revealed to us the presence of streptococcus viridans around the ends of the roots of teeth and the fact that it could be present without causing the slightest irritation.

A strong circumstantial point of clinical evidence to substantiate the fact of the increase in mortality being due to faulty den-



Fig 2

istry is found in the fact that in Great Britain during this period there has been at this advanced age a slight decrease in mortality. This appears to be due to the comparatively small amount of bridge work and the extensive extraction of teeth practiced in the British Isles.

Professor Hartzell has very lucidly described the great abundance of streptococcus viridans around the teeth and the ease with which they can pass through the gingival crevice and then through well defined channels reach the alveolar structure. His own research work shows us that these microorganisms appear to be constantly traveling about these regions. They appear to do no harm until they congregate in such quantity as to produce a distinct nidus of infection. The remarkable vitality of the dental pulp is shown in the fact that in about 50 per cent of cases where attempted devitalization takes place the apical end may retain its vitality. In such cases peri apical infection in the shape of a dental granuloma never takes place. Where however, the pulp tissue is devitalized entirely, infection at the point of the foraminal opening into the alveolar tissue is the invariable result unless correct therapy is followed out.

Research work on pulpless teeth developed the fact that as long as the openings at the ends of the roots through which the pulp with its circulation gained entrance remained

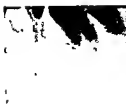


Fig 4



Fig 5



Fig 6

unsealed, infection from streptococcus viridans was not only possible but most probable. Rontgenographs demonstrated the fact that the root-canals could be perfectly cleansed and filled close to the apex of the root and still infection would follow unless the outer end of the root was sealed in such a way that wandering streptococci could find there no resting place.

It was discovered and proved that if the pulp contents were absolutely removed, and any pathogenic tissue present eradicated, and the canals hermetically sealed in such a manner that the sealing material was forced through the apical orifices thus obliterating them *no infection would ensue*.

Rontgenology has proved the correctness of this therapy in showing alveolar regeneration where this operation has been performed thoroughly with all necessary aseptic precautions. This operation is however not an easy one. It consumes a great deal of time and requires infinite skill combined with patience on the part of the operator.

Wherever the rontgenograph does not show the periapical end of the root canal to be absolutely sealed the operation must be considered a failure. Wherever this operation cannot be successfully performed the tooth should be immediately extracted or the unfilled portion of the root be removed by an apicoectomy.

In the city of New York a large number of dentists have adopted this technique, and the statistics of New York State for the past two years begin to show a decreasing mortality in those of advanced life. American dentistry has once more shown its superiority in meeting this problem and being able to save about 90 per cent of pulpless teeth in such a manner that reinfection of this area is unlikely.

Time does not permit me to substantiate as thoroughly as I would like to the very lucid account we have had from Professor Hartzell of the results of these toxamias.

The following case from my practice will suffice to show how clinical observation corroborates the story so well told by Professor Hartzell.

Figure 1 is a rontgenograph of the second upper incuspid over which is showing a well-defined dental granuloma. The patient, a young lady, while crossing the ocean to Italy was thrown from her berth and her entire head was very badly bruised though no thought was given to her teeth. A few weeks after reaching Rome her knees commenced to swell in a typical manner and soon she was forced to use crutches the use of which she was unable to give up during the year and three quarters she was abroad. Prominent orthopedists were unable to give her any relief.

She had been my patient since childhood, and her mouth was in an exceptionally fine sanitary state. Shortly after returning to the United States she thought for about a minute one day that



Fig 7



Fig 8



Fig 9



Fig 10



Fig 11

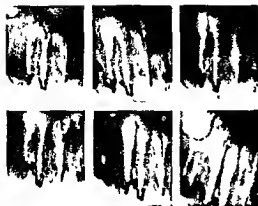


Fig. 12. Upper molar, left to right: (1) March 17, 1911, granuloma quiescent 20 years; (2) October 2, 1911, microorganisms become hemolytic, increase in size. Top affected area; (3) October 4, 1911, first treatment wire through foramen.

Lower row left to right: (1) October 18, 1911, first root filling imperfect; (2) Second root filling correct though extended unnecessarily; (3) January 25, 1915, three years after ionium therapy and root filling. Shows some regeneration.

she noticed some irritation over this lacus-pid. Upon consulting me I took this roentgenograph, and finding this area of alveolar ratification I immediately proceeded to drill into the pulp chamber using the most careful aseptic precautions. The enamel of the tooth was without any blemish but the pulp chamber was entered without the young woman experiencing any sensation. It was found filled with a reddish brown fluid some of which was carefully removed in an aseptic glass pipette.

This was cultural and Fig. 2 shows the well defined streptococcus viridans which was the only organism found.

Figure 3 is a roentgenograph showing the tooth two weeks later after the root canal had been filled. In this case there was no necessity for using our vaccines made from our pure culture of streptococcus viridans for in a couple of weeks she discarded her crutches and although this was nearly four years ago there has not been the slightest return of any arthritis.

Figure 4 is a roentgenograph of a lower lacus-pid showing a well defined granuloma.

Figure 5 shows the tooth during course of treatment with a gold wire inserted through the canal foramen for purely diagnostic purposes.

Figure 6 was taken a year and three quarters after the operation was completed and shows a solid gutta percha filling passing through the foramen which hermetically seals the opening. While it is the aim of the operator to have this gutta percha simply encapsulate the end of the root in

a large percentage of cases it is impossible to limit the protrusion of the gutta percha to this point. Gutta percha is, however, non-irritating and very compatible with body tissue and it has been found, if a thorough aseptic technique has been pursued, new alveolar structure will form in these rarified spaces, without regard to the amount of gutta percha that is forced through the foramen. The most remarkable feature shown in this roentgenograph is the complete regeneration of the destroyed portion of the alveolar process. Attention is called to the callus where the new osseous structure unites with the old and the thickening of this semilunar part of the alveolus is unmistakable.

Figure 7 shows an upper molar in which the pulp has died. This is perhaps the most difficult of all the teeth to operate upon successfully. An idea of the time and skillful technique that is necessary in order to obtain a correct therapeutic result can be obtained from observing the various stages of the operation on this molar.

Figure 8 shows the picture taken after the first operation. Three gold wires can be seen one in the canal of each root. They show the distance that each canal has been explored. None of them have passed through the end of a canal which is essential if the filling is to pass through.

Figure 9 shows the picture after the second operation and shows the three wires have now passed through the ends of all three canals.

Figure 10 shows the roentgenograph after the third operation, and while it is generally possible to fill all three roots at once, this is not always the case in difficult operations on account of the length of time necessary if the operation is to be successfully performed. In this case two entire hours were required to simply fill the large lingual root-canal. Careful observation of this and the following picture will show that this root has not only one but quite a number of foramina entering the end of the root. It also has near its end a division of the canal itself into two canals.

Figure 11 is an illustration of the roentgenograph taken after the fourth operation and shows the completed root fillings in all three roots. This picture shows what might be considered an ideal result. The physician accustomed to study roentgenographs can easily train his eye so that from a good picture taken after a completed operation he will be able to know if this important operation has been successfully performed. Besides encapsulating the end of the root he should be able with a magnifying glass to note that the root filling near the end of the root is homogeneous in character and is hermetically sealing the canal. If it is not accomplishing this result spaces will be found between the filling and the wall of the canal.

Figure 12 shows roentgenographs of an upper central taken at various times during a period of three years. The tooth is first shown in March with a distinct granuloma. The patient declined treatment until October, and the second picture

shows the increase in rarified and destroyed alveolar tissue during this period. The third picture shows the tooth under treatment with a diagnostic gold wire *in situ*. The fourth picture shows that the first attempt at root filling was a failure, the filling failing to pass through the end of the canal. This filling was removed, and the fifth picture shows the perfected root filling, which on account of the large

opening in the end of the root, was forced through some distance. As long as the filling is non-irritable and absolutely aseptic, no harm can ensue from forcing through the end of the root even this large amount of gutta serena. The last one of this series of pictures taken over three years after the operation shows the rarified alveolar structure rapidly filling in with new alveolar structure.

THE DENTAL ASPECT OF THE RELATION OF ENDAMÆBA TO PYORRHOEA ALVEOLARIS¹

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IT gives me great pleasure to bring to this Clinical Congress of Surgeons greetings from the National Dental Association and from its department of research. The Research Institute of the National Dental Association. I wish particularly to express, in behalf of both of those organizations, their deep appreciation for the assistance given in the organizing of the latter by your presiding officer and president Dr. Charles Mayo, and by Dr. George W. Crile, who is also on this platform, both of whom are officers in the Institute, and others of your members who are in the audience. Our dental profession desires to work in the closest

possible cooperation with you on all these common and related problems.

I find on my arrival here that my subject has been changed from "Cinematographic Film Studies Showing the Movements of Mouth Organisms, Including Endamæba," as previously announced, to "The Dental Aspect of the Relation of Endamæba to Pyorrhœa Alveolaris," owing to the inability of your officers to provide for a motion picture machine to be used in this room, due to a conflicting city ordinance. I assure you that they have done all in their power to accomplish it. For your sakes I regret this since, by means of the motion

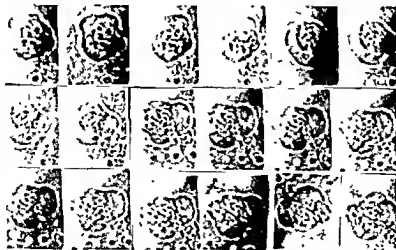




Fig. 2

picture studies of the infecting organisms of mouth lesions we can learn much that cannot be presented in any other way. Many of the organisms of the mouth will not grow on artificial media and are readily recognized and studied by their living characteristics, including, in some instances, a changing motility. We would also have been able to show you both a normal end artery and capillary circulation and the same while changing, due to the introduction intravenously of a small quantity of pathogenic microorganisms which produced a mechanical embolic end-artery block with attending cessation of the capillary circulation surrounding it. This cannot be seen in slides since the moving red blood corpuscles are very distinctly seen as individuals in their rapid migrations through the capillaries and small blood vessels.

In discussing the subject assigned we have to review what will probably prove to be one of the greatest disappointments that will

have come to the dental and medical professions and humanity for sometime. There are many seemingly very strong arguments in support of the endimic etiology of pyorrhea, but there are probably twice as many seemingly as conclusive arguments against it. Owing to the briefness of the time available, I will only be able to summarize them both. A most remarkable and perhaps significant situation exists, in that while splendid authorities are found supporting each side, nearly all of those of distinction favoring the amelia theory are bacteriologists and pathologists whose extended experience and training has been largely or entirely in other fields than the mouth, while of the experienced dental pathologists and bacteriologists of which there are a great number there are scarcely any who do not find after investigation that their judgment is against the deduction. For example, we have in this country an organization known as

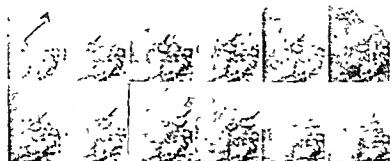


Fig. 3

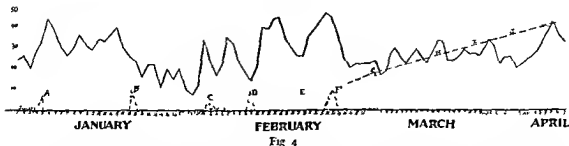


Fig 4

the American Academy of Periodontologists, which is made up exclusively of specialists who are doing practically nothing else but studying and treating this disease, and at their meeting held just a month ago in Detroit it developed that all had been observing very critically, and but few, if any, cases of pyorrhœa alveolaris could be reported as cured or controlled after having been treated with emetin when those cases were judged by the standards that long experience has thought to be adequate, and by which exacting standards probably every person present could include as controlled if not cured many cases treated by other known efficient means. Experienced dental pathologists, however, greatly dislike to use that word "cured" and rarely do so. The use of the word is a bad sign. We have many skilled specialists who have been studying this disease intensively and almost exclusively for ten, twenty and thirty years, and its special pathology is so well understood by them that the hastily made deductions of those without that experience reveal to them in paragraph after paragraph, ample reason to account for the difference in conclusions. In view of the fact that a very great harm can be done by the expounding of a mistaken deduction, it is always a tragedy when the best established data is not used as a check. Many well established principles of dental pathology have been entirely overlooked in the theoretical explanation of the etiology of pyorrhœa alveolaris to provide for the rôle of amœba. It is particularly to be regretted that boards of health have accepted as established a matter of so far reaching importance on so little evidence.

Probably the strongest argument in favor of the endamæbic etiology of pyorrhœa has

been found in the fact that endamæbæ are generally found in pyorrhœa pockets, when there is a profuse flow of pus and, since emetine is almost a specific for the so-called amœbic dysentery, emetin should cure pyorrhœa. The clinical evidence gave some support to this deduction since the administration of emetin in many cases reduces the total quantity of pus flow and the relative cure number of endamæbæ. This seems like a plausible deduction, particularly so if we measure pyorrhœa disease and its cure by the presence or non presence of pus and especially in the absence of evidence to show that the beneficial effect of emetin is accounted for by its action on other organisms, directly or indirectly, or that endamæbæ are not pathogenic. It is probable that at this point there has been the greatest difference in the viewpoint of the dental and medical students of the condition. The trained dental pathologist looks upon the presence of the pus or the reduction of its flow as quite incidental to the establishment of a cured condition. Our specialists have known for years of different methods for producing this change in the symptoms.

In addition to the special studies that have been made by the Research Department of the National Dental Association to establish the rôle of amœba and emetin, this department has also worked in cooperation with selected men in practically every state in the Union, and some from other countries. These men have furnished smears under uniform direction and have provided data. This information establishes that amœbic infection was very universal at the time these slides were made, namely, in February and March of this year, that the use of emetin

locally and by injection in many cases temporarily modified the pus flow. A few claim considerable improvement but from the standpoint of pathological repair, the conditions are not what we could recognize as a cure. A few made very extravagant claims after an exceedingly short use of the drug. While the name pyorrhœa alveolaris assumes the presence of macroscopic pus, many of the worst cases of pyorrhœa alveolaris have no visible pus, though they do show it microscopically. Our studies extending over more than one year of quite critical observation, indicate strongly that the demonstrable presence of endamœba is not a constant factor in Cleveland for certain typical cases. The number of this organism present in a given case, varies, through a wide range, at different periods. In general these organisms are much more prevalent in warm weather than in cold. Certain typical cases without much pus present were studied during November, December, and January, a year ago, and although large numbers of slides were made, the organisms were not often found, nor were they in many mouths without pyorrhœtic lesions. At certain periods in January and February, and with an increasing frequency toward spring the endamœbæ appeared in these mouths and with the approach of warm weather were constantly present and also in a large percentage of patients who were free from pyorrhœtic lesions. Some of these patients had emetin administered and notwithstanding this fact showed these protozoa in large numbers after the treatment, though they could not be demonstrated by the same or any used methods before the treatment. This was not because of the emetin but in spite of it. During this autumn the same condition of varying presence of the organisms in the same mouths has been found on certain days. At certain times practically all patients whether suffering from pyorrhœa or not, may have the organism and a week later it may be absent in a majority of these mouths. It is very significant that the severity of the pyorrhœtic lesion does not show any appreciable change in these same mouths, whether the organisms are present in abundance or so

scarce that they are not found. We have kept a rather careful record of this condition and checked it against the mean temperature. At A and B in January (Fig. 4) the organisms were found in the motile state in pyorrhœtic lesions in which they could not be demonstrated on any other days during that month in those mouths. These patients were not examined every day but two or three times a week. It will be noted that just prior to their appearance on January 4 and 5, there was a sudden rise in temperature from 20° to 50° F and a less extreme change preceded their presence at B on January 19 and 20. In each, February 1 to 3, 8 to 10, and 21 to 24 they were again found in abundance in these same mouths but disappeared in the intervals. During March and April the mean temperature was quite constantly on the rise and they were found in these same mouths on every occasion examined. During April, May, and June they were found in almost every mouth of the small children, even those without traces of pyorrhœtic lesions, as well as in adults without this disease, almost as universally as in mouths with pyorrhœa. During this late autumn they have disappeared again from these same mouths so that very few people without pyorrhœa have the organisms demonstrable and in many of those with severe cases of pyorrhœa they frequently cannot be demonstrated. If endamœbæ are the etiological cause of pyorrhœa, why does not the severity of the attack vary with their presence? It should be stated in this connection that careful observations have been made on all these cases to ascertain if the mouth flora varied at the same time the endamœbæ did and it could not be seen that there was any variation in their numbers or variety.

It seems to be certainly demonstrable that emetin has a definite beneficial effect on certain cases of pyorrhœa, expressing itself not only in the lessening of the number of endamœbæ and total pus flow but also in the tone of the gingival tissues surrounding the pockets. There is, however, an additional improvement in these cases, which has not, so far as we know, been reported except by ourselves, namely, a lessening of the relative

number of microorganisms in the pockets. This is not true of all cases and in those in which it does exist the effect is seen whether the emetin is injected directly into the pyorrhoea pockets, subcutaneously or intravenously. It is not probable that this is due to a germicidal action of the emetin for the dilution is too great when injected elsewhere in the body. Its action is strongly suggested, however, by an immediate change in the phagocytes found in the contents of the pyorrhoea pocket, for these undoubtedly form one of nature's chief defenses against the majority of the mouth microorganisms. We are not certain what the mechanism is, though it seems to be an increase in the stickiness or adhesive property of the surface of the phagocytes, for in these cases after the use of emetin they, the phagocytes, will be found to contain much larger numbers of microorganisms. We have this beautifully illustrated in motion pictures where the contents of the pyorrhoea pocket have been prepared with the same technique before and after treatment and the change both in the number of microorganisms and phagocytosis is very marked. Thus, however, becomes a strong argument against the endamebic etiology of pyorrhoea, since it has never been suggested that they are destroyed by a process of phagocytosis and does account for the beneficial effect of emetin without assigning the result to its amebicidal action. We believe that on this basis we will find that we are greatly indebted to Drs Barrett and Smith for the suggestion of this drug, not so much because of its own beneficial effect and usefulness, as because of the confidence it should give us all to search further and find other specifics that will, in a similar or comparable manner, greatly benefit these cases. Indeed, there is strong evidence that such an agent will be found, if one has not already been found, in succinimid of mercury, for the introduction of which we are indebted to Drs Wright and White. They claim practically 100 per cent "cures." We have been making studies with this drug and, while we have not had the successes claimed by the gentlemen suggesting it, we believe it to be superior to emetin in a majority of cases. We find, however, that

the criticisms that we have made in the beginning of this address, relative to the standards by which pyorrhoea is declared to be "cured," are applicable here, for the chief change in the lesion is the quantity of pus. Greater care must be taken in using the drug because of the susceptibility of many patients and consequent danger of mercury poisoning, which shows itself probably more quickly in the structures with which we are dealing than in any other tissues of the body. Has it occurred to you why this is so? Is it not true that it is the practice of every man in this room to look at his patients' gums when he suspects mercury or lead, etc., poisoning? Why do you do so? It is because of the abnormal susceptibility of these tissues to systemic irritation. The alveus is, by its nature, being an end organ, a transient tissue. It does not exist in either babyhood or old age, and, like the hair, the system tends to dispense with it at the approach of very early signs of decadence.

Another argument against the amebic etiology of pyorrhoea is found in the clinical picture which is familiar perhaps quite exclusively to those who are devoting themselves to an intensive study and clinical treatment of pyorrhoea alveolaris. It is variously spoken of as a bacteremia or toxemia following the procedure of instrumentation for mechanically removing the deposits from about the necks of teeth and within pyorrhoea pockets. It not infrequently occurs that the reaction upon the patient will be so great that there will not only be great local soreness of all the teeth as a result of the procedure but a rise of temperature often accompanied with considerable prostration. This occasionally will put the patient in bed and will last for a day or two. It is not demonstrated what the mechanism of this reaction is. There is strong evidence, however, that the temporary disturbance of nature's defense in the soft tissues permits of the entrance into the circulation and lymph stream of motile organisms. The endameba that is considered responsible for this lesion is designated as the endameba gingivalis, Gros, by Drs Barrett and Smith or endameba buccalis by Drs Bass and Johns, probably the same organism.

Had we been able to use the motion pictures you would have seen readily that this organism has a very slight power or tendency to project itself across the field. It throws out lobose pseudopods first in one direction and then in another, usually with the tendency to a rhythmic flow of the pseudopods wave in consecutively circular order (see Fig. 1). Unlike the *kartulisi* variety (Fig. 2), which is the species of endomirbia found in many cases of pyorrhea, it seldom migrates longitudinally. This latter species migrates quite rapidly and continuously in the same direction and could be conceived of as entering more freely into the tissues surrounding the pockets. An argument for the amebic etiology has been that while other organisms may be the active cause the endomirbia buccalis by its migration over the granulations, dries the infecting bacteria on to and into the tissues and thus effectually plants them. If we could see the various organisms in the pyorrhea pocket in the motion pictures we would see that many of them can swim circles around the amebic like butterflies playing around a turtle, and except for the non motile varieties there seems little occasion to provide such a slow means of transportation. If we were to provide a rapid carrier for the micro organisms, we would find it in the ciliated protozoan shown in Fig. 3. This is only found in a small per cent of the pyorrhea pockets but it has migration speed probably one hundred times greater than even the *kartulisi* variety. It is about the size of a leukocyte, is a ciliated protozoan and tends to keep under the debris. The relative motility of these two species of endomirbia and this ciliated protozoan can be seen in the illustrations. In the first two the motion pictures were taken at the rate of sixteen per second and only every seventh picture is shown here so that the change between one picture and the next, in Figs. 1 and 2, are at about one half second intervals reading from left to right and from top downward. Figure 2 shows clearly the successive sequence of pseudopodic action. The relative size as compared with an erythrocyte is shown by the dark objects just above the endomirbia buccalis. In Fig. 2 of the *kartulisi* the

organism is seen to migrate about one-half its own length in a little over six seconds. Of course, these are pictures of living organisms not of stained specimens. In Fig. 3 the motion picture camera was run at the rate of twenty pictures per second and none were cut out so that the twelve pictures shown represent about one half a second instead of six seconds as in Fig. 2. It will be observed that this ciliated protozoan has moved practically across the field in this half second.

The progressive pathological stages of pyorrhoeic lesions indicate very definitely that one of the most, if not the most, important factors is inherent in the tissue itself. There is not time to discuss this at length but we will call your attention to one of these factors, namely, that these lesions progress continually toward the apex of the root and but slightly laterally. It is difficult to account for this phenomenon as a purely infective process. Again this progressive destruction can be started at will in practically any mouth by the placing of almost any possible irritant against the gingival tissue in such a position as to either displace it or hold bacterial masses in contact with it. If it were a simple infective process, why does not the placing of such an irritant, as suppose an impinging bridge making pressure on the alveolar side at a point distant from either of the supporting teeth produce a typical lesion. It will produce an irritation of the mucous membrane from which there may even be a systemic invasion but there is not the progressive destruction of the alveolar bone, as develops when this irritant is placed in the same relation to the periodontal tissue. An important factor is, therefore, to be found in the structures immediately surrounding the roots of the teeth. This limitation will, of course, apply to all organisms that may be related to the lesion, unless they can be shown to have a specific liking for some element in the periodontal tissue. Black and other histologists have reported at length on the existence in the periodontal membrane of chains, strings and clusters of epithelial cells which run parallel with the long axis of the root and are possibly related to the formative

enamel organ. Black considers them normal to the location because they are always present in both man and the higher animals.

We are strongly of the opinion that when the true etiology of pyorrhœa is understood it will be found that some of the microorganisms of the mouth which do not grow on artificial media and which, consequently, are, as yet, slightly understood, will be found to play a much more important rôle than do endamæbæ. In fact we believe we have found one which we can readily recognize with the motion pictures, which refuses to grow in any artificial media that we have found that does not contain blood, preferably the blood from the patient from whom it was obtained, and is killed by blood of other patients and of certain animals. The presence of the irritating substance, whether a deposit of tartar, an ill fitting crown or filling, a mass of food or a mass of bacterial detritus, will be sufficient to call out from the tissue the elements of the blood stream necessary for developing their special and acquired appetite. The removal of the irritant immediately robs them of the intermediate means for providing this special food. There is indication that the progress of this disease toward the tooth apex is related to these chains or threads of epithelial cells which exist in the pericemental tissue. After they, with their symbionts, have destroyed the pericemental tissue opening up the minute alveoli or bone cells of the alveolar bone, the latter become ideal fields for streptococcal infections, which are planted directly from the mouth. In these protected areas of varied oxygen tension, the various strains of streptococci are developed, which select out with great regularity certain tissues of the body which they reach through the blood stream and which they infect by embolic processes. We see no more reason based on the evidence already submitted for claiming that endamæbæ are the chief etiological factors in pyorrhœa than for blaming it upon

any one of several other mouth microorganisms which, like the endamæba buccalis, will not grow on any artificial media that we yet know of and which organisms are as constantly present in the pyorrhœa pockets as are this protozoan. It is our belief that not until we know very much of these but little understood organisms will we have solved the problem as to what the real etiology of pyorrhœa alveolaris is.

In the meantime it seems to be our duty to withhold judgment and recognize that it has not been demonstrated that any one organism is the chief etiological factor in pyorrhœa alveolaris. The evidence in favor of assigning it to endamæba gingivitis or buccalis is, we believe, entirely circumstantial. More definite evidence must be established before we can say that it is, or that it is not, the cause. Typical lesions can be artificially produced without its presence. If this should be accomplished with this organism as the chief agent it will quite quickly establish it as an important factor. Drs Barrett and Smith are of the opinion that the evidence does not justify the differentiations between the various varieties of endamæba, including the histolytica. The most certain phase of this pyorrhœa problem seems to be that more exhaustive research is imperatively demanded in the interests of humanity, who are paying and will continue to pay such a terrible price so long as our two professions remain in ignorance as to the true facts underlying its etiology, cure and prevention.

BIBLIOGRAPHY

- 1 HARTZELL and HENRICK. J. Nat. Dental Ass., II, 2, Report Minn. Div. Nat. Dental Research Commission, *ibid.* p. 4.
- 2 PRICE and BENNING. J. Nat. Dental Ass., II, 2.
- 3 WRIGHT and WHITE. Dental Cosmos, LVII, 779, Wright, *ibid.*, 1903.
- 4 BASS and JOHNS. Dental Cosmos, LVII, 102 4/5 1209.
- 5 BARRETT and SMITH. Dental Cosmos, LVII, 101, 1201. J. of Parasitol., I, No. 4, 159.

INTESTINAL STASIS¹

By A. J. OCHSNER, M.D., LL.D., F.A.C.S., CHICAGO

EVERY author of note from Hippocrates to the present day, who has written a treatise on medicine, has insisted upon the importance of preventing an abnormal accumulation of excrement in the large intestine, both as a prophylactic against future, and as a cure for existing, disease. In most instances these authorities repeat this warning and give advice many times throughout their works in connection with the various diseases under consideration. Almost every author has some remedy or he outlines a method of combating this condition and recommends his remedy again and again. Many a practitioner of medicine who enjoys great renown in his own community or in wider circles owes his renown largely to the fact that he provides in some way relief for his patients against this harmful condition. Many world-renowned watering places owe their fame very largely to the laxative qualities of the water.

Every language and every dialect of the languages with which I am familiar, either by direct knowledge or by inquiry, has a number of proverbs in prose and in verse which impress upon the popular consciousness the fact that abnormal accumulation of excrement in the colon causes ill health.

In many instances this fact is linked with other important facts to ensure emphasis and even the economic side of the problem is brought into use because a person may not fear ill health so much as he may fear the doctor's bill which he is certain to incur in case he disregards this important hygienic precaution. This is illustrated by many proverbs, of which but one may be quoted which is known to every German speaking man, woman, and child:

"Den Kopf halt kalt, die Fuesse warm
Und überlade nie den Darm,
Halt stets die Hinterstüre offen,
Dann hat der Dokter nichts zu hoffen."

A very large percentage of the various proprietary remedies which have received

popular approval, owe their continued use to the fact that they contain senna or some other equally reliable laxative. Since the introduction of liquid paraffine only a few years ago, millions of pints of this lubricant have been sold because this remedy will prevent, without causing distress, accumulations of excrement in the colon in a very large number of individuals.

Twenty five years ago, while serving in the capacity of chief assistant in the surgical clinic of Prof. Chas. T. Parker, I observed the fact that in most cases in which the post-operative progress was unsatisfactory, one of the most constant conditions complained of was obstinate constipation. As a result of this observation, each one of the thirty-six thousand patients I have personally operated upon since that time, has received a laxative upon leaving the hospital, to be used in case of constipation. As a rule, these patients have also been given a diet calculated to favor digestion so as to produce normal evacuations of the bowels.

It seems proper to speak at length upon these features in order that we may not be accused of pretending to discuss a subject which is entirely new in which there is an insufficient amount of clinical observation to warrant positive conclusions.

It is true however, that the more obstinate cases belonging to this group, have recently taken upon themselves importance from a surgical standpoint. Within the past few years this condition under the name of "Intestinal Stasis" was brought before the surgical world most forcibly by Sir Arbuthnot Lane whose views have been fully supported by no less famous a scientist than Metchnikoff. During this time, scores of papers have appeared covering every phase of the subject. Some of the most important ones of these are presented in abstracts in the references accompanying this paper. The etiology, pathology, differential diagnosis, and the study of the condition with the X-

¹ Read before the Clinical Congress of Surgeons of North America, Boston, October 25-28, 1913.

ray, have all received a large amount of attention. The effect of this condition upon the function of almost every organ in the body has been discussed, and practically every pathological condition not due to some specific bacterial infection or some definite traumatism, has been attributed to intoxication caused by intestinal stasis, and this has been considered as an important predisposing cause for many of the pathological conditions the exciting causes of which are definitely known.

On the other hand, the treatment of this condition has been viewed from almost every imaginable and imaginary angle from the radical excision of the colon to mechano, psycho, or hydro-therapy. Efficiency of surgical treatment has ranked in the expressed opinion of authors from the marvelous down to the statement that it is usually harmful and always useless.

A sufficient period of time has now elapsed to justify definite opinions from those clinicians who make a careful study of new theories and forms of treatment before supporting or condemning them without regard to their high or low origin, and without being influenced by previously established views.

Those clinicians who at first became interested in the surgical treatment of cases suffering from intestinal stasis, have had an abundance of this material to observe, because these patients know of other similar sufferers and refer these to the surgeons in whose service they have met many patients who have been treated for the same infirmity. Quite propitiously for the surgeon especially interested in this condition, the method of visualizing the exact form and position of the intestines has been introduced through the use of bismuth or barium suspension and the X-ray.

This method has resulted in an endless number of errors because of faulty technique and lack of experience in translating the findings, but it has served as a most convincing argument in causing the patient to submit to operative treatment, and this in turn has made it possible for the surgeon to accumulate clinical data which will be of great value in the future.

Our personal experience in the Augustana Hospital extends over a period of five years since we first became interested in the writings of Lane. These cases will all be analyzed in a future paper which will contain a full discussion of immediate and late results. During the year ending December 31, 1914, we operated upon thirty-six cases, with thirty-two recoveries and four deaths, giving a mortality of a little over eleven per cent. All of these cases were operated upon by my colleague, Dr. N. M. Percy, and myself.

These cases represent less than 10 per cent of all the cases which came under our care during this period, for the relief of intestinal stasis, and still the number operated upon contains some cases which should not have been treated surgically, as has been shown by their subsequent condition. This is true especially of a few neurotics who undoubtedly suffered as a result of intestinal stasis with marked auto-intoxication due to absorption of products of decomposition. All of these neurotic cases showed marked improvement after the operation. In a certain proportion, however, this seemed to last only until some unusual or unexpected circumstance upset the regularity of the digestive process, when they seemed to glory in the consciousness that they were again enjoying a type of ill health which they could attribute to the abnormal condition of the intestinal tract. These patients seem to take especial pleasure in the fact that they are again miserable. In some of this class of cases we have performed a second or third operation, but only rarely with the result of obtaining permanent relief.

Occasionally a case that obtained relief after several operations was suddenly overtaken with fear that his life would be shortened because an important portion of his alimentary canal was not contributing anything to the digestion of the food he consumed. In one instance, the patient begged to have the condition restored to the original, so that he might again make physiological use of his entire colon.

In a few cases of short circuiting there was a filling up of the descending, the transverse,

and even the ascending colon, and the caecum with faecal matter following the ileosigmoidostomy. In order to prevent this in cases in which the walls of the gut seemed to show so little vigor as to make it likely that this complication would result in filling up the unused portion of the colon, we have made a provision for relieving this in case it should occur, by a very safe and simple device, similar to that described by Francis Reder.¹

The portion of the ileum which remains attached to the caecum when the intestine is severed for the purpose of making an ileosigmoidostomy, is brought out through an opening in the abdominal wall directly in front of the caecum through a muscle splitting incision and sutured in this place so as to project for a distance of about one cm. Then the usual ileosigmoidostomy is made by an end to side operation in order to prevent annoyance from the presence of the blind end which one has to deal with if one closes the free end of the ileum and makes a side to side operation.

In case any fecal material accumulates in any part of the unused portion of the colon this can be removed very readily by inserting a large catheter into the caecum through the stump of the ileum and flushing the intestine freely with soap suds or with normal salt solution or a quantity of oil or glycerine, or the oil may be introduced first and this may be followed an hour later by flushing. It seems wise to make use of this method in all cases in which the operation is performed notwithstanding the presence of markedly neurotic tendencies.

Regarding the etiology of intestinal stasis much has been written, some of which has been generally accepted, especially in regard to bands causing obstruction in the vicinity of the ileocecal valve.

There can be no doubt but that mechanical obstruction due to bands or constrictions can cause intestinal stasis. The same is true of pressure from uterine or ovarian tumors, or as a result of congenital or acquired anomalies of the colon, such as have been described by Wilms, Babcock, and others.

The general downward displacement, en-

teroptosis, of the intra-abdominal organs and especially the transverse colon, is frequently found in patients suffering from intestinal stasis. In these cases, however, our experience seems to indicate that the enteroptosis is caused primarily by gaseous distention of the intestines which has stretched their peritoneal supports to such an extent that they cannot be restored to normal. This same overdistention of the intestines seems to have weakened the circular muscles so greatly that their vigor in forcing the intestinal contents forward has been markedly reduced. In this way we have a weakened mechanism for overcoming the stasis on the one hand, while the lengthened mesenteric support prevents the intestine from having a substantial support against which it can contract.

We have found this condition in patients who had suffered severely from digestive disturbances during infancy with severe gaseous distention of the intestines. We have also found it in many patients who had suffered from gaseous distention during attacks of typhoid fever or appendicitis or puerperal infection.

With the elimination of these conditions through more careful feeding of infants, through prevention of typhoid fever by vaccination, and by the drinking of water that has not been contaminated with sewage and through prophylactic elimination of peritonitis from other causes, a large class of cases of intestinal stasis will undoubtedly be prevented in the future.

Sir Arbuthnot Lane² says in the last edition of his book: "Doubtless at no distant time many of the toxic conditions that arise in consequence of stasis may be met with by some means other than operative."

It seems as though not only the toxic conditions, but that the cause of these conditions should be met by proper prophylaxis before the support of the intestines and the muscular structures have been permanently injured. It would consequently seem proper to credit the pediatrician and the general practitioner with the elimination of a great part of suffer-

¹ Surg., Gynec. & Obst., 1914, xix, 96.

² The Operative Treatment of Chronic Intestinal Stasis (third edition, page 63).

ing from this cause in the future, because of the constant attention our colleagues in this special branch of practice are giving to infant feeding.

Dr Chester C. Waller,¹ has pointed out the fact that in a considerable number of children suffering from severe gaseous distention of the intestines, the patient is affected with subacute appendicitis, and that the removal of the diseased appendix will be followed by relief from the gaseous distention. No doubt, in many cases, the adhesions which result from the long continued presence of subacute appendicitis cause a certain amount of mechanical obstruction which will increase the stasis caused by the weakened condition of the circular muscles of the intestine. We can consequently give surgical aid in this class of cases in infants and children, which will have much value from the standpoint of prophylaxis.

There can be no doubt but that the surgical relief of demonstrable mechanical obstruction causing stasis will in many instances give complete or almost complete relief, the result depending upon the degree to which the stasis is due to a removable mechanical obstruction. In a very large proportion of cases, however, the cause is not single, and for this reason one should look for only partial relief following surgical treatment. Lane has recently advised the removal of not only the entire colon down to the sigmoid flexure, but also a portion of the lower end of the ileum, because it is this portion which is frequently unable to force its contents into the rectum, and he seems to have demonstrated that these patients do not suffer from the loss of this part of the ileum. This theory is borne out by many experiments by Flint and others, as well as by observations in patients in whom more than 200 cm. of small intestine had to be removed for various reasons. It seems that the ileum is much more likely to be defective in its ability to force its contents downward than is the jejunum, probably because it is so much more likely to have suffered from gaseous overdistention.

Selection of cases for surgical treatment. Ordinarily it seems wise to eliminate all

neurotic patients whose nervous condition cannot be traced directly to intoxication caused by intestinal stasis. As only a very small proportion of all cases suffering from neurotic conditions have developed their neurosis as a result of auto-intoxication due to intestinal stasis, it is best not to treat any of these surgically unless there are other conclusive symptoms which make it fairly certain that the case under consideration is undoubtedly suffering from a neurosis which is secondary to intoxication caused by intestinal stasis, inasmuch as all other neurotics are usually very much worse a short time after they have submitted to surgical treatment than they were before. As a consequence they are not only harmed individually, but they help to discredit surgical treatment.

Contra indication to surgical treatment. The class of neurotics whose nervous condition has not been caused by intoxication due to intestinal stasis, should come first among the patients in whom surgical treatment for existing intestinal stasis is contra-indicated, because they form a very large portion of cases applying for operative treatment. Many of them have already had their normal ovaries removed, they have had their round ligaments shortened, their kidneys suspended, and their rectal mucous folds severed. Appendectomy, and in some cases of late, cholecystectomy have been performed, gastroenterostomy has been made and sometimes the intestine has again been severed from the stomach for the purpose of relieving conditions supposed to have been brought about by the gastroenterostomy. Elystram has been relieved by the use of prisms and tenotomy, the nasal mucous membrane has been carefully cauterized, and a submucous operation has been performed for the relief of deflected nasal septum. In fairly old patients, other operations may have been performed, or some of those enumerated above may have been repeated. In short, there is a class of patients who insist upon having every new method of treatment tried, and they are quite certain to hear about this form of treatment as new and effective, and unless the surgeon who operates for the relief of intestinal stasis observes great care, he will

¹ Surg. Gynec. & Obst. 1915 251 950

experience much disappointment after operating upon this type of individual.

Aside from this group of patients, operative treatment is contra-indicated in all instances where careful and long-continued hygienic, dietetic, and medicinal treatment results in physiological relief. The proportion of cases in whom diet, exercise, massage, freedom from mental and nervous strain, and regular habits regarding the time of evacuating the bowels, will result in permanent relief, provided attention is constantly given to all of these details, is so great that only a very small percentage of patients suffering from intestinal stasis will remain who need to be considered from the surgical standpoint.

Surgical patients then are those in whom there is a possibility of overcoming intestinal stasis by removing the cause of obstruction existing in the form of tumors pressing upon the intestine, the correction of uterine displacement compressing the rectum, obstruction due to bands of adhesions, or marked kinking of intestines, of strictures due to cicatricial contraction following ulcer of the intestine, of annular carcinoma of the intestines and occasionally of large papillomata, fibromata, or lipomata projecting into the intestine.

How can we determine in the first place the existence of intestinal stasis, and in the second place, the location and character of the obstruction?

SYMPTOMS OF INTOXICATION DUE TO INTESTINAL STASIS

1 *Constipation* The most constant symptom is, of course, the persistent constipation which may however, be interrupted at times by diarrhœa caused directly by the irritation in the colon as a result of the accumulation of hardened feces, or from indiscretion in diet, or the use of medicines. In these cases, however, the evacuations do not remove the hardened fecal accumulations in the colon, but pass by these on the way from the small intestine. This condition is always late in its appearance after constipation has existed for a considerable period of time, because the diarrhœa of this type is due to irritation of the mucous lining of the intestine, and is

consequently related to the stasis only in a secondary manner.

2 *Malnutrition* Patients who are suffering from chronic intestinal stasis are badly nourished, because the condition reduces the appetite and thus the amount of food ingested, and because it impairs the digestion, and consequently the patient does not obtain the normal amount of benefit from the food taken.

3 *Skin changes* The complexion of patients suffering from intestinal stasis loses its clearness, the skin becomes yellow with brown spots, dark areas appear beneath the eyes, and there is pigmentation of the skin in the axilla, the groins and other flexures.

4 *Impaired circulation.* In most instances the circulation is impaired, as is manifested by the presence of cold hands and feet, and the presence of a cyanotic condition of the skin. The patients are short of breath upon attempting severe muscular exercise or upon mounting stairs.

5 *Impaired muscular strength* These patients complain of weakness and inability to perform their accustomed amount of physical work. They become exhausted easily and do not recuperate quickly upon taking rest.

6 *Impaired resistance* Intercurrent diseases are borne badly by these patients, as their normal resistance seems to be greatly below par.

7 *Effect upon the nervous system* These patients are greatly depressed nervously. They may develop melancholia or hysteria. It is of course, important to determine which has been the primary condition in these cases.

Many neurotics develop intestinal stasis as a secondary condition, their neurotic condition having some other foundation. The intoxication resulting from the intestinal stasis increases the unfavorable symptoms in these cases and treatment for relief of intestinal stasis usually improves their general condition. However, unless this intoxication is the sole cause, they soon become worse again and quite commonly, considerably worse than they were before the treatment was begun, especially if this treatment has been surgical in character.

One is, however, quite as likely to make the mistake of rejecting patients in this class who are curable by surgical treatment as to operate upon those whose condition will be made worse, even though one exercises great care in making a differential diagnosis.

Lane and many of his disciples give many other symptoms, and some of these have attributed practically every possible symptom to toxæmia caused by intestinal stasis. No doubt this toxæmia has a harmful effect upon the physiologic functions of every organ of the body, and by placing great weight upon this item, one can read its influence into the history of almost every patient. Just as the dietician or the climatologist can find causal relations between disease of every form and the subject of his especial interest, so can the practitioner who is an enthusiast in the study of intestinal stasis, apply his fad, notwithstanding the exaggerated importance placed upon this condition by these specialists. However, there is undoubtedly enough in this subject that is of real practical value to deserve the careful attention of every clinician.

BACTERIAL STUDY

Nathan Mutch¹ has made extensive studies concerning the bacterial activity in the alimentary tract in connection with intestinal stasis, as a result of which he has formulated twenty-three conclusions which seem worthy of the attention of those interested in this subject, but our limited space will not permit their discussion in the present paper.

It seems proper, however, to express the opinion that undoubtedly the conditions present in patients suffering from intestinal stasis favor the development of an enormous increase in the bacterial flora of the alimentary canal, and that this occurs with harmful effect on the patient's health, but it does not seem likely that a study of these bacteria can assist materially in determining the form of treatment indicated in the individual case.

X-ray examination. There are so many opportunities for error in the study of patients for the purpose of determining the presence of intestinal stasis by means of the X-ray, that nothing short of a long-continued

actual observation with subsequent inspection of conditions found during operation can justify an opinion based upon X-ray examinations, and then only in conjunction with a careful study of the history and a thorough physical examination of the patient.

Without these precautions, the X-ray findings are certain to be misleading, as has been demonstrated innumerable times when plates were made by the X-ray specialist and read by the clinician.

The clinician should first become thoroughly familiar with the many variations in the normal subject, and he should then study cases in whom he has made a diagnosis of intestinal stasis as a result of a study of the history and a careful physical examination. Then he should compare his findings with those determined during the subsequent operation and from these observations he should develop his personal judgment of values of X-ray appearances both on the fluoroscope screen and on plates.

As a guide for normal conditions, the statement of Alfred C. Jordan,² seems entirely satisfactory if his method is closely adhered to.

Method recommended by Jordan quoted verbatim.

The method which has afforded me the most trustworthy information in demonstrating the existence of chronic intestinal stasis, is the administration of an emulsion of four ounces of carbonate of bismuth and an ounce and a half of sugar of milk in a tumbler of water about an hour after an ordinary breakfast. No aperient or enema should be used for two days previous to or during the investigation. All meals should be taken as usual.

Posture. The patient is upright while taking the bismuth, then he is examined on the couch.

The normal subject. In a normal case the bismuth passes rapidly through the esophagus into the stomach when regular peristaltic waves are seen and small portions of the bismuth may enter the duodenum. The result of the introduction of the bismuth is that in the erect posture the greater curvature falls about one inch below the level of the umbilicus.

Examining the patient on the couch, regular peristaltic waves move along both curvature to the pylorus, and bismuth enters the duodenum and passes through the four parts of the duodenum as the result of a normal duodenal peristaltic wave, and enters the jejunum. The duodenojejunal junction is rounded offering no obstruction to the course of the bismuth. The second part of the

¹ Brit. J. Surg. 21, No. 8.

² Third Edition of Lane's Monograph, p. 100.



Fig. 1



Fig. 2



Fig. 3

Fig. 1 Case 1, so-called anatomic position of colon. Plate shows hepatic and splenic flexures high, ascending, descending, and transverse colons in the theoretic proper position and of moderate caliber. Haustral contractions well marked.

Fig. 2 Same patient as in Fig. 1, twenty minutes after hypodermic injection of 1/50 atropine sulphate. Note the low position of hepatic flexure, tortuosity of transverse and descending colons with apparent redundant

sigmoid and slight incompetency of the ileocecal valve. Splenic flexure still high.

Fig. 3 Case 2, so-called anatomic position of colon with chronic constipation. Plate shows (before and after atropine) ileocecal valve competent, moderate dilatation of ascending colon, slight right-sided V-dip to transverse colon, splenic flexure high, normal sized descending colon, slight dilatation of sigmoid. Entire colon shows haustral contractions of moderate strength.

duodenum measures $2\frac{3}{4}$ in. to $3\frac{1}{4}$ in. It is usually impossible to obtain a skiagraph of the normal duodenum for with an ordinary time exposure the bismuth may be seen to leave the duodenum after a few seconds. If an instantaneous method be used but a portion of the (normal) duodenum is shown, for only a part of it contains bismuth at any particular moment.

By the end of two or three hours the whole of the bismuth has left the stomach, being seen widely scattered through the small intestine, but especially in the lower coils of the ileum above the pelvic brim.

After three and a half to four hours bismuth has begun to enter the caecum.

After five or six hours there is no longer any bismuth in the small intestine, the whole of it occupying the caecum and ascending colon.

At the end of eight to twelve hours some bismuth has reached the splenic flexure.

After twenty-four hours the bismuth is distributed through all parts of the large intestines, some having reached the rectum or having been evacuated.

At the end of forty-eight hours the whole of the bismuth has been evacuated.

It should be stated that in many normal patients small portions of bismuth may be noticed frequently in the colon for a longer time than forty-eight hours, but the greater portion will have been evacuated by this time.

We have selected sixteen X-ray plates, taken from cases which were as nearly typical as possible, to illustrate the position, size, and general appearance of the colon when filled with bismuth or barium in suspension. It is perfectly clear that each one of these illustrations has a definite meaning when considered in connection with the history of the patient under consideration, but it is equally clear that without this history no one could place great value upon any of these.

It is, of course, quite different in cases in which the plates demonstrate the presence of a stricture, an enormous dilatation, a sharp kink, or the presence of a tumor causing the obstruction. To the lay mind, any one of these plates would serve as an argument which would induce him to submit to almost any operation, and unfortunately many surgeons have been the victims of a form of autosuggestion induced by the apparent evidence contained in such plates, and as a result of this influence many useless and many harmful operations have been performed upon the colon.



Fig 4

Fig 4 Case 3 so-called anatomic position of colon with chronic diarrhoea. Plate shows incompetent ileocecal valve, slight dilatation of ascending colon right sided V dip to transverse colon which is in good position spasticity of descending colon with apparent redundancy of pelvic colon ("partial puddling")

Fig 5 Case 4, atypic position of colon with normal stools. Plate shows (after atropine) competent ileocecal



Fig 5



Fig 6

valve long spastic ascending colon with apparent sharp V dip transverse colon from hepatic flexure, normal size, transverse colon narrow, spastic descending and pelvic colons

Fig 6 Case 5 atypic position of colon with chronic constipation. Plate shows (after atropine) competent ileocecal valve, tortuosity of transverse colon, spasticity of descending colon redundancy of sigmoid

SO CALLED ANATOMIC POSITION OF COLON

CASE 1 Barton, male, 17 (Fig 1) Previous infectious diseases measles and scarlet fever. Bowel movements regular, daily, never uses cathartics

Diagnosis Diabetes insipidus

Figure 1 shows the hepatic and splenic flexures high, ascending, descending and transverse colons in the theoretic proper position and of moderate caliber

Figure 2 Same patient as Fig 1, twenty minutes after hypodermatic injection of 1/50 atropine sulphate

The plate shows the low position of hepatic flexure tortuosity of transverse and descending colons with apparent redundant sigmoid and slight incompetency of the ileocecal valve. The splenic flexure is still high

SO CALLED ANATOMIC POSITION OF COLON WITH CHRONIC CONSTIPATION

CASE 2 Male age 44. Complaint constipation five days if medicine not taken. Uses four pills nightly. Pyorrhea alveolaris epulis left cheek high blood pressure myocardial hypertrophy abdomen ill tenderness licking

Figure 3 shows before and after atropine. ileocecal valve competent moderate dilatation of ascending colon slight right sided V dip to transverse colon splenic flexure high normal sized descending colon slight dilatation of sigmoid entire colon shows contractions of moderate strength

SO CALLED ANATOMIC POSITION OF COLON WITH CHRONIC DIARRHOEA

CASE 3 Male, age 52. Complaint chronic diarrhoea and 'dyspepsia'. Typhoid at 44. Persistent morning diarrhoea for twenty five years, with gassy distention of the abdomen, weakness, loss of appetite, headaches, clammy cold hands and feet, weight loss, sallow skin, and "thumping of heart"

Findings Secondary anaemia Trace of albumin in urine Low blood pressure Achylia gastrica Mushy stools with enormous numbers of flagellate protozoa yeasts torulae acid fast rods spirilla, and phosphate of ammonia crystals

Figure 4 shows incompetent ileocecal valve, slight dilatation of ascending colon right sided V dip to transverse colon which is in good position spasticity of descending colon with apparent redundancy of pelvic colon ('partial puddling')

ATYPIC POSITION OF COLON WITH NORMAL STOOLS

CASE 4 Male age 46. Old history of tonsils, sore mouth, bad breath coated tongue, frequent urination (due to enlarged prostate)

Clinically Hyperacidity Cystitis Enlarged prostate Secondary anemia Weakness and headaches

Figure 5 shows after atropine competent ileocecal valve long spastic ascending colon with apparent sharp V dip of transverse colon from hepatic flexure Normal sized transverse colon narrow spastic descending and pelvic colons



Fig 7



Fig 8



Fig 9

Fig 7 Case 6 Atypical position of colon with chronic diarrhea. Plate shows incompetent ileocecal valve, dilated appendix and ascending colon, convoluted spastic transverse and descending colon, redundancy and dilatation of the sigmoid and rectum.

Fig 8 Case 7 Redundancy of pelvic colon with normal stools. Plate shows (after atropine) competent ileocecal valve, spastic low ascending colon and cecum, irregular and spastic transverse colon, wide splenic flexure,

spastic descending colon, great redundancy with partial spasticity of sigmoid and rectum.

Fig 9 Case 8 Redundancy of pelvic colon with chronic constipation. Plate shows (after atropine) competent ileocecal valve, slightly dilated cecum and ascending colon, "twist" of junction of hepatic flexure and transverse colon, somewhat dilated and very spastic transverse and descending colons, marked redundancy of pelvic colon.

ATYPIC POSITION OF THE COLON WITH CHRONIC CONSTIPATION

CASE 5 Male, age 44 Typhoid twenty five years ago. Few years afterwards had beginning of obstinate constipation. Can't get bowels to move without enemata and compound cathartic pills. Then has diarrheic stools for several days. No abnormal pain, appetite poor, weight constant, tires easily on exertion, moderate drinker of spirits.

Examination Ruddy, full blooded, nervous type, overnourished. No abdominal tenderness, gastric secretions normal, stool dry hard. No mucus.

Figure 6 shows after atropine competent ileocecal valve, tortuosity of transverse colon, spasticity of descending colon, redundancy of sigmoid

and spastic transverse and descending colons, redundancy and dilatation of the sigmoid and rectum.

REDUNDANCY OF PELVIC COLON WITH NORMAL STOOLS

CASE 7 Male, age 46 Chronic mastoiditis. No complaints otherwise.

Figure 8 shows competent ileocecal valve, spastic, low ascending colon and cecum, irregular and spastic transverse colon, wide splenic flexure, spastic descending colon, great redundancy with partial spasticity of sigmoid and rectum.

REDUNDANCY OF PELVIC COLON WITH CHRONIC CONSTIPATION

CASE 8 Male, age 54 Comes for chronic constipation and epulis of left lower jaw. Constipation nearly all life (34 years). Takes three pills at bed time or bowels would never move.

Examination Epulis on left lower jaw, pyorrheal abscesses, teeth very poor, skin pale, not sallow, anemia secondary, heart—myocardial hypertension, arteriosclerosis.

Figure 9 shows competent ileocecal valve, slightly dilated cecum and ascending colon, "twist" at junction of hepatic flexure and transverse colon, somewhat dilated and very spastic transverse and descending colons, marked redundancy of pelvic colon.

REDUNDANCY OF PELVIC COLON WITH CHRONIC DIARRHEA

CASE 9 Male, age 62 Complaint chronic diarrhea (10 years), weight loss, anemia, weakness,

ATYPIC POSITION OF COLON WITH CHRONIC DIARRHEA

CASE 6 Female, age 60 Proctitis all life. Well otherwise, except for years of chronic diarrhea. Has six to eight stools daily, associated with faint spells. Vague distress about precordia, dyspepsia, gassy abdomen, cold extremities, weakness, headaches and nausea.

Examination Waxy, tired, nervous, sallow type. Secondary anemia (Hemoglobin 60 per cent). Enlarged thyroid. Myocardial weakness, low blood pressure. Tenderness in right lower quadrant and over gall bladder, hemorrhoids.

Figure 7 shows incompetent ileocecal valve, dilated appendix and ascending colon, convoluted



Fig 10



Fig 11



Fig 12

Fig 10 Case 9, redundancy of pelvic colon with chronic diarrhoea. Plate shows (after atropine) competent ileocecal valve, gassy ascending colon, dilatation of hepatic flexure, spastic transverse colon, dilatation of descending colon, great redundancy and moderate dilatation of the pelvic colon (sigmoid and rectum).

Fig 11 Case 10, general dilatation of colon with normal stools. Plate shows (after atropine) competent

ileocecal valve, dilated ascending colon, tortuous dilated transverse colon, moderate dilatation of descending colon and sigmoid, redundant sigmoid.

Fig 12 Case 11, dilatation of all parts of the colon with chronic constipation. Plate shows incompetent ileocecal valve, dilated ascending colon, tortuous partly dilated transverse colon, dilated and partly spastic descending colon and dilated, redundant sigmoid.

headaches, dizziness, shortness of breath, coldness and numbness of hands and feet.

Examination. Dry, sallow, wrinkled skin, decayed teeth, pyorrhoea alveolaris, arteriosclerosis with hypertension, left heart, enlarged prostate, rhytids. Gastric stool contained great numbers of entamoeba histolytica yeasts, acid fast rods, and spirilla.

Figure 10 shows competent ileocecal valve, gassy ascending colon, dilatation of hepatic flexure, spastic transverse colon, dilatation of descending colon, great redundancy and moderate dilatation of the pelvic colon (sigmoid and rectum).

GENERAL DILATATION OF COLON WITH NORMAL STOOLS

CASE 10. Male, age 44. Tonsillitis, with rheumatoid swelling of joints of right hand and wrist together with axillary lymphangitis. Marked pyorrhoea alveolaris with many decayed teeth.

Figure 11 shows competent ileocecal valve, dilated ascending colon, tortuous dilated transverse colon, moderate dilatation of descending colon and sigmoid, redundant sigmoid.

DILATATION OF ALL PARTS OF COLON WITH CHRONIC CONSTIPATION

CASE 11. Female, age 27. Comes for 100 pounds weight loss in one year, weakness, headaches, chronic constipation (eight years), and dyspepsia associated with pain of colicky character below left costal arch.

Examination. Undernourished, neuronic female, bruntic, sallow skin (during past five years).

Infected tonsils, simple hypertension of thyroid gland, myocardial weakness, abdominal tenderness over gall bladder. Gastric mobility normal. Free hydrochloric acid 46. Stools pasty and contain enormous numbers of cercariae hominis together with many yeasts, ammonia crystals, mobile rods and spirilla.

Figure 12 shows incompetent ileocecal valve, dilated ascending colon, tortuous, partly dilated transverse colon, dilated and partly spastic descending colon and dilated, redundant sigmoid.

DILATATION OF ALL OF COLON WITH CHRONIC DIARRHOEA

CASE 12. Male, age 24. Comes for chronic diarrhoea, twenty five pounds weight loss (18 months), weakness, pallor and headaches.

Examination. Pale, undernourished. Thyroid enlargement. Flabby heart muscles with low blood pressure. Secondary anaemia. Gastric mobility normal. Free hydrochloric acid 18. Stools contain great numbers of entamoeba histolytica, yeasts, acid fast rods, cocci, ammonia crystals, and spirilla.

Figure 13 shows markedly incompetent ileocecal valve. Dilated ileum, great dilatation of ascending and part of transverse and descending colons, redundant sigmoid.

INCOMPETENT ILEOCECAL VALVE WITH NORMAL STOOLS

CASE 13. Female, age 40. Comes for headaches, hyperacid stomach, and weight loss (old pulmonary tuberculosis).



Fig 13



Fig 14



Fig 15

Fig 13 Case 12 dilatation of all of colon with chronic diarrhoea. Plate shows incompetent ileocecal valve, dilated ileum great dilatation of ascending and part of transverse and descending colons, redundant sigmoid

Fig 14 Case 13 incompetent ileocecal valve with normal stools. Plate shows stomach in systole markedly incompetent ileocecal valve with dilated terminal ileum,

gassy dilatation of ascending colon, partly dilated and partly spastic transverse colon spastic descending colon with redundant and dilated sigmoid

Fig 15 Case 14, incompetent ileocecal valve with chronic constipation. Plate shows markedly incompetent ileocecal valve dilatation of terminal ileum dilatation of ascending colon, spastic transverse and descending colons, redundant sigmoid

Figure 14 shows stomach drawn in systole. Markedly incompetent ileocecal valve with dilated terminal ileum gassy dilatation of ascending colon, partly dilated and partly spastic transverse colon, the descending colon is spastic and the sigmoid is redundant and dilated



Fig 16 Case 15 incompetent ileocecal valve with chronic diarrhoea. Plate shows markedly incompetent ileocecal valve dilated ileum marked dilatation of ascending and part of transverse colon "twist" at splenic flexure, dilated and redundant pelvic colon

INCOMPETENT ILEOCECAL VALVE WITH CHRONIC CONSTIPATION

CASE 14 Female, 37 Constipated for fifteen years. Eight years ago appendectomy and removal of right ovary and tube. The patient came for treatment on account of a weight loss, headaches, nervousness, and dyspepsia of grill bladder type.

Examination Florid type. Nervous and fairly well nourished. Old tonsillitis. Thyroid moderately enlarged. Abdomen moderately distended with tenderness over grill bladder region. Stomach mobility normal. Free hydrochloric acid 42. Stool, pasty and firm scybalae.

Figure 15 shows markedly incompetent ileocecal valve dilatation of terminal ileum, dilatation of ascending colon, spastic transverse and descending colon, redundant sigmoid

INCOMPETENT ILEOCECAL VALVE WITH CHRONIC DIARRHOEA

CASE 15 Male, age 27. The patient had had diarrhoea for several years, with weight loss (twenty-five pounds in one year), weakness, headaches, nervousness.

Examination Undernourished. Dilated heart, low blood pressure. Secondary anaemia. Gastric mobility normal. Free hydrochloric acid 18. Stools contain entamoebae.

Figure 16 shows markedly incompetent ileocecal valve, dilated ileum, marked dilatation of ascending and part of transverse colon, "twist" at splenic flexure, dilated and redundant pelvic colon

OPERATIVE TREATMENT

In a general way the operative treatment must remove the cause to be successful.

If the cause is due to pressure upon the intestine, this must be removed. If it is due to bands or kinks, these must be relieved. If for any reason the obstruction cannot be relieved in this way then short-circuiting must be resorted to, and if the colon is dilated with its muscular walls so seriously impaired that their power of contraction has been permanently destroyed, then at least the cæcum and ascending colon should be removed; and in severe cases it may become necessary to remove the entire colon down to the sigmoid flexure.

We have followed the method described by Lane. If it were possible to acquire his great skill and dexterity, the operation need not be considered with much anxiety, but for a surgeon not of unusual skill it must be looked upon as an operation involving grave risk.

The following short abstracts give the views of a number of surgeons who have given especial attention to this subject.

CHRONIC INTESTINAL STASIS, "AUTO-INTOXICATION" AND "SUBINFECTION"

Adam¹ states that Lane's kinks and bands of similar nature are met with in cases with lax abdominal walls with more or less atrophy of recti and other muscles, and that the cause of visceral displacement is lack of due support. He believes these bands are non-inflammatory in origin and are formed by "stress hypertrophy of the connective tissues produced by pull of the badly supported bowel on its mesenteric attachments."

Intestinal intoxication may be attributed to any of three causes: (1) products of disintegration of food stuffs in bacterial activity, (2) products of disintegration of food stuffs in the digestive juices, (3) ectotoxins discharged by intestinal bacteria. Adam lays most stress on the fact that nearly all symptoms cited by Lane may be explained by subinfection. In cases of stasis, blood cultures were found positive. Either bacillus coli or streptococci were found present. The nature of the organism responsible for the disturbance and its probable seat of entry should be discovered and other means of procedure should be taken before operation is advised.

J. M. Hunt² has shown by a series of experiments carefully carried out that as much as 50 per cent of the entire small intestine in dogs may be re-

moved successfully. Resection of 75 per cent may survive, but do not truly recover. The first effects are diarrhoea, thirst, and increase of appetite and loss in weight. The patients remain extremely sensitive to changes in diet and living. Human cases behave as do animals. Five resections of over 400 cm. have recovered. The diet later should be poor in fats and rich in carbohydrates.

Goldthwait³ shows that intestinal stasis in cases suffering from visceroposis is only one of many abnormal conditions found in the same individual. He thinks that visceroposis is the result of the animal taking on an erect posture which has not been properly compensated, for which he suggests intelligent use of proper corrective measures as a preventative.

He described *acquired visceroposis types*. When the body is relaxed or drooped, the whole body suffers, the pelvis changes its inclination, the diaphragm and abdominal walls relax, and the splanchnia droop. Many people of such type do not, however, have symptoms referable to visceroposis.

There is also a *congenital visceroposis type*. Anatomists tell us that one person in every five has a looser attachment for the hollow viscera than is normal. They are usually poorly nourished and are subject to tuberculosis, arthritis, pyorrhæa alveolaris, tonsillitis, neurasthenia, anæmia, and therefore, also intestinal stasis.

Goldthwait insists that in treating patients with chronic conditions in the intestines, the body should be considered as a whole and that the individual symptoms referring to an organ should be interpreted in the light of the condition of the whole individual.

Franklin H. Martin⁴ states that general visceral ptosis is indicated by a characteristic attitude while standing and by muscular inefficiency.

General visceral prolapse leads to intestinal stasis, digestive disturbances, neurasthenia, "Lane's kinks," "Jackson's membranes," kinks of the pylorus, the cystic duct, the duodenojejunal junction, the appendix at the termination of the mesoappendix.

These bands often become fixed by adhesions and corrective measures must be instituted in order to produce a cure.

In uncomplicated general ptosis or those complications which have been corrected by surgery, gymnastic and other mechanical treatment goes against permanent rebel in the congenital type.

The treatment consists in substituting active muscle exercises for passive exercises and rest, the exercises exerting the greatest advantage with the patient in Trendelenburg position; and by reinforcing the muscular parietes at the beginning of the treatment by properly constructed supports to be worn while standing.

The author believes that this treatment will prevent relapse of the complications of ptosis, if they are first relieved by appropriate surgery and thus make unnecessary the radical operation of

¹Adam, J. G. Abstracted Internal Abn. Surg., 1924, xviii, 580.

²Hunt J. M. Tr. Conn. St. Med. Soc., 1919, p. 253.

³Goldthwait J. E. Penn. M. J., 1914, April.

⁴Martin Franklin H. Surg. Gynec. & Obst., 1917, xv, 150.

Lane, or the operation of Coffey which has for its object expansion of the upper abdomen.

In discussing this subject, Mayo¹ points out the fact that because of high fixation of the splenic flexure the contents in the first half of the large intestine are detained in the area of absorption, and that beyond the splenic flexure there is but little absorption. The descending colon is usually empty; hence it is often thought to be contracted in X-ray pictures. Material placed in the rectum is quickly carried to the head of the colon for absorption. Tumors of the caecum and ascending colon are often accompanied by metabolic changes, i.e., profound anemia, etc. This is not true of tumors of the large intestine beyond the splenic flexure. Functional disorders of the large intestine, especially in the caecum and descending colon may disturb metabolism through absorption of deleterious products and produce conditions variously called intestinal putrefaction, intestinal stasis, etc. It is possible that mechanical conditions of developmental origin have the same effect in retaining remnants of food too long in the absorbing one half of the colon and that symptoms are due to the effect of toxic products on the controlling sympathetic ganglia.

Moynihan² states that everything indicates that a sort of apathy is as a rule the cause of stagnation, not an obstruction which is with difficulty overcome. Symptoms of Lane's disease are "easily recognized and caused to disappear by proper surgical treatment. Hemigastrotomy alone gives but little relief. Nothing short of colectomy offers a substantial chance of cure. The end of the ileum, caecum, and ascending colon should be removed. He does not agree with Lane regarding the number of diseases which are cured by correction of intestinal stasis.

The reflex of contraction above and inhibition below a stimulated point of the gut is not the same as normal peristalsis and is not always in control of the bowel mechanism. Alverez³ seeks to explain these activities by viewing the gut as a tube with greater tone and rhythmicity at the oral end. Thus a rise of tone at the upper end due to introduction of food or irritating lesions would hurry the abnormal process of food, while a similar rise at the lower end would slow the current or even reverse it. A rise anywhere in the middle should cause material to flow in either direction (?). This view explains and is consistent with the observed effects of introducing food at the upper digestive tract (hastening a contrast meal by a second meal, cessation of vomiting by giving solid food etc.), of jejunal feeding of irritant lesions at different levels (showing of food coming toward the lesion from above and hastening of that already passed it), and with certain phenomena of constipation.

Lane's⁴ last band at pelvic brim, develops to resist tendency of gut to gravitate into small pelvis, develops very early. It later becomes a real ligament, and prevents regurgitation.

Tuberculosis and rheumatism due to "auto-intoxication" Ileum joined to sigmoid below this kink especially in tuberculosis cases leads to marked improvement.

Technique Peritoneal interval between ileum and rectum must be closed. Hypodermoclisis is begun as soon as anesthetic, it reduces shock.

Missus causes degeneration of breast and cancer.

Finney⁵ s. Problems of diagnosis present greater difficulties and are further from solution than those of treatment.

1. Certain operative procedures, gastro-enterotomy, e.g., have reached such a state of perfection that they are a possible menace and call for greater care in proper selection of cases.

2. The tendency to dogmatize on too little evidence in causation and treatment of fundamental intestinal neurosis should be discouraged and a more scientific observation substituted therefore.

3. As a result of knowledge gained by such comprehensive and exhaustive study, it is not unreasonable to hope that ultimately, in carefully selected cases, surgery may offer relief to this unfortunate group of gastro-intestinal neurosthenias.

Case⁶ Alimentary toxemia and intestinal stasis are not the same. The ratio between the intestinal stasis and the individual's defensive powers determines the grade of toxemia. X-rays can only show mechanical evidences of intestinal stasis. Case wants four to five days for a complete examination (X-ray). Always makes a complete stomach and colon examination. Fluoroscope is more reliable than plate. Intelligent palpation while viewing is very important. Horizontal position best. There are many variations of normal colon. The most frequent finding in constipated people is marked spasticity of the left half of colon, especially below the crest of the left ileum.

Case⁷ has formulated the following conclusions as a result of his congenitologic observations on the function of the ileocolic valve.

1. The ileocolic valve is almost universally present in vertebrate animals. It is competent to enema, withstanding enormous distention of colon by fluid and gas.

2. The valve may be rendered temporarily incompetent by friction on valve lip by a string passed through alimentary tract.

3. In about 1/3 of 1000 persons, most of them constipated and all suffering from gastro-intestinal disturbances, the lumbar enema passed the ileocolic valve and filled the terminal ileum for varying distances.

¹ Lane. The First and Last Kink in Chronic Intestinal Stasis.

² Finney. Some problems in gastro-intestinal surgery, J Am Med Ass. 1911, 204, 1913, 1914, June.

³ Case, James T. Basic constipation in the Roentgen study of intestinal motility. J Am Med Ass. 1913, June.

⁴ Case J T. J Am Med Ass., 1913, October 3.

¹ Mayo W J. Abstracted Internat. Abstr. Surg. 1913, vol. 506.

² Moynihan Sir Berkeley. Internat. Abstr. Surg. Gynec. & Obst., 1913, 22, 134.

³ Alverez Walter C. San Francisco. The Motor Functions of the Intestine from a New Point of View.

4 Valve incompetency determined in this manner is a constant phenomenon found in these cases

5 These (4) cases describe characteristic disagreeable symptoms apparently due to passage of the small intestine

6 In cases showing a marked degree of stasis a reflex of ingested bismuth from the colon back into ileum is also observed

7 Occurrence of incompetency to a large degree is independent of the temperature or composition of the opaque enema

8 Incompetent ileocecal valve may be restored to competency by a simple surgical procedure, competency persisting in the same cases one and one half years

9 In operations performed upon patients who have incompetent ileocecal valves the small bowel is found filled with gas to a disturbing degree

10 It is possible in operation of ileosigmoidostomy to construct an efficient artificial ileocolic valve which successfully acts as a barrier against reflex from the colon

11 Definite deviations from the normal anatomic structure are found at operation in cases of ileocecal valve incompetency

12 Post mortem studies show ileocolic valve competent in the majority of cases

Fahler's¹ methods and ideas are about the same as those of Case, only he believes more in series of plates than in fluoroscopic examination

Facts to be analyzed²

1 Chronic constipation

2 Dilatation and atony of the colon, especially of the cæcum

3 Enlargement and displacement and movability of the colon, especially the cæcum, both congenital and acquired

4 Colitis from faecal stagnation

5 Pericolicitis with formation of adhesions and so called membranes

6 Obstructive symptoms due to these adhesions with resulting (a) colics and (b) ileus

¹ Fahler George E. The study of chronic intestinal stasis by means of X-ray Surg. Gynec. & Obst. 1914 xix 653

² Bayan Arthur D. Dilatation of the large bowel J Am Med Ass., 1915 lxv 112

CHRONIC INTESTINAL STASIS AND ITS ASSOCIATED SO-CALLED TOXÆMIA¹

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IT is particularly encouraging that at a gathering of this kind, Dr Ochsner should have so well defined the limitations of the surgical art in the cure of "intestinal stasis" and the "toxæmia" which it has been quite loosely assumed goes with stagnation of ileal contents. While during the past ten years there has been much surgical enthusiasm over the operative relief of colon stasis, it has been difficult for the physiologist or the internist not to believe that much of the interest of the surgeon lay in the successful mastering of intricate and novel operative maneuvers. In the fascination of performing operations of the type suggested by Lane, it would seem that not infrequently the question of ultimate benefit to the patient has occupied a minor position.

Dr Ochsner has quite well defined the type of case in which surgical procedures for the relief of intestinal stasis offers the least disappointment. It would seem that in the

selection of material for either surgical or medical procedures, it is quite necessary to consider the means at our command for demonstrating, (1) the clinical proof that stasis exists, (2) that with this stasis there is a toxæmia, and (3) what surgical or medical measures are available for the alleviation of one or both the above conditions.

1 *Proof of the existence of stasis.* As a rule it does not require a medical diploma for one to be able to determine the existence of delayed evacuation of the bowel in a given individual. The patient usually makes the diagnosis himself and resorts to a physician for relief only when common household remedies have failed. That many individuals who are constipated are of the type described by Lane is well known and has been the common knowledge of both doctor and layman for centuries. There are no definite statistics at hand, however, that actually demonstrate that the constipation class of the human

¹ Discussion of Dr A. J. Ochsner's Paper "Chronic Intestinal Stasis and its So-called Toxæmia" read at the meeting of the Clinical Congress of Surgeons of North America, October 25-30, 1915.

family is made up largely of swarty, clumsy, sallow, glum looking, feebly-acting people. On the other hand, it is well within the clinical experience of all of you that many patients who conform physically to the "Lane type" have normally acting bowels and that numerous instances of obstinate constipation present themselves where the individuals are rosy checked—even plethoric—and mentally alert. It should be recalled, when considering the clinical type popularized by Lane, that many of these individuals have passed the time of life when exuberance of circulation and of spirits is logically to be expected. Many of these patients have had severe damage done to the body economy by disease and not a few have experienced mental trauma. Moreover, the group upon which surgical operations are performed is essentially a picked group—it includes persons who are as it were, in the last stages of distress from faulty evacuation of the bowel. Naturally when statistics are collected regarding the type of individual associated with intestinal stasis, the surgical group upon which operations have been performed is composed largely of the "Lane type" individuals. It would seem to me that it is impossible to say that there exists clinically a distinct type of individual, which type has resulted from intestinal stasis alone.

X ray demonstration of stasis. With a very few exceptions, actinologists are quite prone to consider an intestinal function entirely at fault when an opaque meal administered by mouth is not completely evacuated by the natural channels in forty-eight hours. Jordan, working with Lane, has been particularly active in claiming that the X ray method was of valuable clinical service in showing intestinal stasis. Jordan's published report of his technique of examining this type of case, definitely states that the opaque motor test-meal is administered to stasis cases without the bowels having previously been emptied. In an individual who presents himself at a clinic for the relief of a constipation, where in many instances evacuations from the bowel have not taken place for days or even weeks, it is quite difficult to see how one can expect an artificial meal such as is used

by roentgenologists, to pass from the intestinal tract within anything like "normal time." From what we know of barium or bismuth compounds, physically and chemically, it is difficult to understand how such substances can either permeate material already blocking up the lumen of the bowel or how these can work their way past inspissated fecal material and later be discharged. It is not astonishing that in practically all cases of constipation that are examined by the X ray method as outlined by Jordan, plates demonstrate retention of the opaque meal for varying lengths of time. It would seem to be somewhat miraculous, if in an individual whose colon is already picked tight with dried material, a heavy metal compound such as bismuth, could work its way out of the intestinal canal. In our experience in determining the patency of the intestinal channel, particularly of the colon, it has been shown that only reliable information can be obtained when the motor power of the gut is determined by a meal administered by mouth, after the intestinal canal has been thoroughly cleaned out twenty-four hours previously.

That the commonly employed opaque meals are physiologic, has not yet been proved by even the most enthusiastic actinologists. Pawlow, Cannon, Carlson, and others have repeatedly reported experimental work which proves how important psychically, with respect both to secretion and motility, are those impressions conveyed to individuals or animals as the result of a meal appealing to the special senses. Sight, taste, smell, and even color all contribute to proper gastrointestinal activity. To anyone who has had personal experience with the way patients regard opaque roentgen meals, it is not necessary to explain that the feeling toward such is one of non interest at least. To many, the meals are disgusting. This being true, it is impossible to regard the evidences of stasis as shown by the X ray method as being entirely reliable. Even if the special senses were satisfactorily catered to by opaque roentgen meals, it must not be forgotten that a large quantity of bismuth or barium is from its nature, chemically, not wholly inert in the intestinal canal. It is well within the

experience of all of us that one of the common remedies administered to control diarrhoea, is bismuth. Whether such bismuth has its affect as a sedative to an irritated intestinal lining, or whether it kills infecting organisms or it neutralizes poisons, it is impossible to state. The clinical fact remains, however, that commonly diarrhoea is stopped after the administration of bismuth. It does not seem altogether clear, why we should expect large volumes of bismuth administered to an ailing patient, to pass through the bowels as does a meal that the patient himself has chosen according to his own desires and which excites the secretions of the gastrointestinal canal and which stimulates a physiologic motor apparatus.

In our clinic, we have definitely shown that such a thing as "normal time" for opaque meals to pass through the intestinal canal is a term which demands wide interpretation. Quite commonly, individuals in perfect health (orderlies, elevator boys, nurses and the like), to whom barium or bismuth compounds have been administered by mouth showed retention of the opaque meal in the colon from three to five days. In these individuals, no evidences whatever pointed to constipation or intestinal stasis. On the other hand, we have instances where patients came in with obstinate constipation, but evacuated the motor meal within forty eight hours, or with very slight delay, if previously the intestinal canal had been freed from old retention contents. Moreover, in both normal and constipated individuals, we have shown that if the individual be examined at different times, there is a wide variation in the hours it takes the opaque meal to pass through his gut.

During the past year it has been our custom to estimate the rate of onward progress to food through the intestinal canal by the administration, with ordinary food, of such inert non-diffusible materials as carmine or lycopodium. The coloring matter is administered with food of the patient's own choosing in a small capsule and note is made of the time when stools are passed, stained with the dye or mixed with the spores of lycopodium. Sometimes it is difficult to

feed a hearty meal to a chronically constipated individual. The majority of these patients are mal-nourished, inasmuch as after years of constipation, they feel that harm is done to the body economy by the ingestion of meals which they either know or think will not be later evacuated. This factor of chronic mal-nourishment may be a not negligible one in bringing about a chronic pernicious form of ailment in an individual who, initially, was affected with but a temporary upset. When a coloring matter is administered in the above manner, results are quite striking. In our experience the majority of patients who claimed that intestinal stasis of the obstinate type existed were demonstrated to pass stained stools well within the time limit of people with normally acting bowels. In but a few cases, were unstained stools not recovered within thirty-six hours after the administration of the coloring matter. Not uncommonly, in these obstinate cases, an enema revealed that stained material lay in the sigmoid and rectum awaiting evacuation and such material could frequently be discharged spontaneously by the patient upon regular effort. It would seem that the above simple method for determining the presence or absence of actual stasis offers possibilities in determining the selection of individuals for different forms of therapy.

Dr Ochsner has already emphasized very graphically that opaque enemata are not to be relied upon too greatly for the indications that stasis exists when plates show as result mal-position of the colon. In our experience it has been shown that the colon may occupy a multitude of positions following the administration of opaque enemata and that the clinical evidences of mal-function bear but a slight relation to the position that colons occupy as shown by the X-ray plate. Moreover, in a given individual it is not infrequently possible to secure pictures indicating wide variation in the position of the colon when plates are made in series. These variations in position can well be observed if observations are carried out with the aid of the fluoroscopic screen after enemata have been given. They can be well observed and profitably studied after the administration of large

doses of atropine hypodermatically. Not only does the position of the colon change as shown by a series of plates, but very often angulations, twists, and kinks can be demonstrated which appear to have particular significance only if they are looked to as causative factors in the production of an existing obstinate constipation. Dr Ochsner has already shown that the demonstration roentgenographically of "incompetent ileo-cæcal valve" bears absolutely no relationship to the clinical picture. We have numerous instances where markedly "incompetent ileo-cæcal valves" have been shown in connection with chronic constipation, chronic diarrhoea, or absolutely normal stools. The physiologists have frequently informed us that there is a "physiologic incompetence of the ileo-cæcal valve." If plates happen to be made at the time that the valve is open, regurgitation of the opaque meal into the lower ileum may be expected in all types of cases, clinically. While certain uncorroborated chemical and bacteriological studies of the contents of the lower ileum have been reported by Mutch from instances of intestinal stasis, it does not seem to us that roentgenographically there is any evidence to indicate that "intestinal stasis" really means "ileal stasis." Lane, who has the largest experience in handling cases of chronic constipation, finds the fewest instances of incompetent ileo-cæcal valve.

Of course, it is granted, that when organic causes of stasis are present (tumors, diverticula, adhesions, stenoses from chronic ulcer, and the like) roentgenograms are of valuable service in accurately localizing the seat of the lesions. However, in this type of case, definite, clinical manifestations of mechanical hindrance to the onward progress of bowel contents are but rarely lacking and the clinical history is commonly characteristic.

2 *Proof of the existence of a "toxæmia" dependent upon intestinal stasis.* I have already commented upon the variability of the clinical appearance of chronically constipated folk. Although Lane and his co-workers have laid strong emphasis upon the unusual biochemic and bacteriologic findings in the gut (particularly the terminal ileum)

of individuals who came to operation on account of intestinal stasis, these observers have never produced by the administrations of these "poisons," in experimental animals or humans, the general or local anatomic defects which, dogmatically, they claim result from faecal stagnation and retention. Among bacteriologists and chemists, there is much skepticism regarding the possibility of poisons or abnormal bacteria passing from the lumen of the gut directly into the systemic blood or lymph streams. It should be recalled that the bowel wall is not merely an inert animal membrane filter, whose porosity varies according to laws, purely physical. The contents of the gut are separated from the circulating body fluids by a *riable* animal membrane in which complex biochemic processes are constantly being carried on. All dependable experimental evidence indicates that even were "split proteins," ptomaines, aromatic compounds, soluble bacterial toxins or pernicious microorganisms constantly present in abnormal quantities of the bowels affected with faecal retention, such inimical substances rarely pass unaltered through the wall of the intestine. Thus far scientists have generally shown that a chief function of the gut is to render such harmful material inert. No evidence is forthcoming that establishes the fact that where intestinal stasis exists, the normal functions of the bowel wall are permanently altered and that this alteration could be directly ascribable to the stasis itself. It is quite likely that preceding stasis some not yet understood damage may have been done to the bowel wall which damage permits of abnormal interchange between the circulatory streams and that the stasis itself may be but a result of this underlying fault.

I have been frequently impressed with the history of chronic undernourishment in many of our stasis cases. This undernourishment has not rarely long antedated the history of chronic constipation. Most of these patients have previously been affected with infectious ailments and in the majority of these individuals local foci of infection can be demonstrated if carefully searched for. Decaying teeth, pyorrhœa alveolaris, infected

tonsils, sinuses or lymph glands and, upon laparotomy, diseased appendix, gall-bladder, fallopian tubes and the like are common findings. In most of the cases, the clinical evidences that these foci of infection existed long before the onset of chronic constipation are readily established. I feel that this association of chronic, partial starvation (particularly in females) and the presence of germ centers in some part of the body can not be too strongly emphasized with regard to the subsequent onset of intestinal stasis. In all stasis cases, not only should the history of previous infectious diseases be ascertained, but careful search should be made for the persistence of local infected foci. That such foci, in the presence of faulty feeding, fatigue or irregular habits, may become extremely harmful, has been demonstrated by Woolley and by Olmer. The latter has shown that when such opportunities are given, bacteria multiply very rapidly. The increase can be actually proved by culturing the venous blood. Improvement in the general body state is accompanied by prompt sterilization of the venous blood. It would appear that local foci of infection, particularly if such are closely connected with the digestive tract, have a not altogether unimportant influence upon the subsequent development of a type of imperfect bowel function which is associated with infrequent evacuations.

3 *Proof that surgical or medical measures are available for the treatment of intestinal stasis or its associated so called "toxemia"* No clinician of experience will deny that whatever means are used to aid this unfortunate class of patients, the task is a difficult one. To alter the psychic state alone of these individuals is itself a problem. Certainly, early attempt should be made to rationalize these

folk. Not rarely, the elimination of their fads is as difficult as is the elimination of their intestinal contents.

The best results of treatment come from the earnest cooperation of patient, surgeon, and internist. The internist must seek surgical aid in eradicating all local infected foci, wherever in the body such may be situated, before he can hope to begin successfully hygienic, dietetic, gymnastic, or medicinal procedures. If the stasis persists after a reasonable interval of non-surgical care and laparotomy seems advisable, then such *laparotomy should always be exploratory in the fullest sense of the term*. Very commonly the removal of an infected appendix, a gall-bladder filled with stones, a peptic ulcer, a foul uterus and its adnexia, or the separation of obvious bands or adhesions, will render unnecessary the uncertain "short-circuiting" operations. The last type of procedure should surely be avoided whenever possible, for in a given case, at the time of laparotomy, one can never prognose what future functional state will exist following the "short circuiting". Even when the surgeon has done a perfect job mechanically, patients very frequently later present themselves to the internist on account of obstinate and distressing diarrhœa associated with abdominal pain or constipation of a degree exceeding even that experienced before operation. Not only are anomalies of the bowel demonstrated, but in some of our cases I have been able to show that a definite diminution has taken place in the digestive quality of the secretions of the stomach mucosa, the liver, and the pancreas. Such abnormalities generally resist treatment and then the woe of the patient is as great as is the perplexity of his medical attendants.

OBSERVATIONS ON SANITARY ORGANIZATIONS AND SURGERY IN FRANCE AND THE CENTRAL EMPIRES

A PLEA FOR SURGICAL PREPAREDNESS

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INTRODUCTION

A BASIC lesson of the present times is that war, like disease, ever confronts humanity. Against the ravages of war as against that of infectious bacteria, national salvation has lain only in clean living, in the upbuilding of fighting strength in time of peace, and in the storage of knowledge and material wherewith to fight and to repair when conflict comes.

Those of us who have been in contact with the destruction and repair now going on in Europe, owe it to this country to put our limited observations on record for future reference. As against infections, so against war, preparedness is the one vital lesson we bring home.

The surgeon deals with the repair stage of conflict, he forms the salvage corps of war. It is to learn how best to save that we meet tonight. In our own past wars we have been negligent. We have slaughtered our soldiery by unnecessary disease and infection. That dark page is closed. May our future be illuminated by the highly organized conservation exhibited in this war. In this saving, the Art of Surgery has played a minor rôle. The great saving has been effected through preventive medicine. It is in the control of epidemics, of typhoid, cholera, typhus, and the bloody flux of armies, this has been the great triumph. Yet, surgery and the surgeon have occupied a dramatic place and contributed in no small way to the saving of life and national resources. When aided by efficient organization, modern surgery has been able in no small measure to control infection and thus neutralize the increased ferocity of modern mangling.

I will endeavor to record, in the brief moments allotted to me, certain of those features of the surgery of this war, from which we must draw our lesson for surgical preparedness.

For six months through the past winter I had the opportunity to observe certain phases of the surgery in the war zone, first with Dr. Joseph A. Blake, at the American Base Hospital at Paris, later with Dr. Walton Martin and the Columbia University Unit in establishing the Whitney Hospital in the war zone of the Sixth French Army. Then through the past spring I had the privilege of a tour of observation over Germany, Austria, and Hungary, by courtesy of United States Ambassador Gerard and General Oberarzt Schultzen, Surgeon General of the War Ministry in Berlin.

NATURE OF THE WOUNDS

Brushing aside the dramatic prejudice, the average wounds of war differed little in the immediate pathology from the traumatic cases we see in New York City. Yet the experience of years of civil practice was condensed into weeks in the war zone by the quantity, severity, and variety of wounds. Also the conditions under which the wounds were received, together with the inadequate facilities for treatment, all combined to materially modify the phenomena of wound reaction.

What impressed me most was that the wounds of war were inflicted under the worst possible circumstances. The person and the clothing of the soldier were dirty. The wounds were necessarily neglected, for be it remembered, the treatment of wounds is not the prime object of war. The wounded were the debris of conflict to be carted to the rear when transportation becomes possible. Although I knew these facts, yet on going into the war zone I was profoundly impressed by the inevitable delays following the infliction of the wound before adequate surgical attention such as drainage became available.

Even under the most favorable conditions

of a highly organized battle line and relatively few wounded in Northern France through the winter months, it required, in the average, a day to get the wounded man back out of shell fire, through the various organizations of the front; the first aid station, the ambulance dressing station, the field hospital, etc., back to the evacuation hospital. From thence it averaged anywhere from one to three days before adequate surgery was obtainable in the service of the rear. The English service over a short front became somewhat more efficient after six months of fighting. On the German front in the West, the service between trench and forward base hospital soon became a model of expedition. On the East front, however, under the severe conditions prevailing last winter it required four to six days before adequate surgery of the rear could be rendered.

Aside from the wound being a neglected wound, the next most striking feature of the wounds of war was the frequency of retained infectious foreign bodies. The metallic missiles themselves were usually well tolerated, but all the missiles with the possible exception of the smoothly spinning rifle bullet, carried more or less infectious debris. The predominant wounds of the French front were from exploding shell and shrapnel, from glancing bullets, fragments of steel and rock, and other low velocity missiles. These carried with them into the tissue an amazing amount of detritus.

It was not uncommon in following the tract of a low velocity missile, such as a shrapnel ball, to fish out from successive depths of the wound six or more layers of clothing, overcoat, blue uniform, red and blue woolen sweaters, layers of dirty undershirts, and even various pocket articles. It was this septic foreign material which gave the wounds their most notable characteristic, namely, wounds richly insemminated by a variety of pyogenic and saprophytic organisms, and sure to develop under conditions of neglect, the characterizing feature of the wounds of war, infections of unusual and virulent type.

In the establishment and severity of these infections, a direct relation could always be observed between the efficiency of organiza-

tion and the virulency of infection. Thus, when in the first rush, at the battle of the Marne, the sanitary corps on both sides were overwhelmed, the wounds reached the first base hospital practically untreated, six to ten days after they had been inflicted. The battle was fought on a highly infectious soil. Septic infection, gas gangrene, and tetanus took a fearful toll of the wounded. The immediate loss of life was no more appalling than the maiming. For half a year afterward I saw in the base hospitals of France and those of the Valley of the Rhine, the aftermath of the terrible infections of that period, suppurating knee joints, chronic osteomyelitis, conical stumps from wide open amputations and other sequelæ of severe neglected infections. Later in the conflict when the sanitary organizations improved, I noted with interest how the virulency of the infections diminished. Tetanus almost ceased under routine prophylactic dosage of antitoxin. Gas phlegmon became a rarity with prompt drainage of the wounds. In spite of the increased proportion of severe shell wounds as the open fighting became a siege, and despite the fact that the wounds continued to show a rich flora of pyogenic and anaerobic bacteria on culture, yet the prompt efficacious drainage of the latter months of the war largely prevented severe infections.

The predominant type of wounds differed in various localities. On the East front of the German Army which I visited in March, where the fighting had been more open than in the West, about 70 per cent of the wounds were from rifle fire. Apparently the Russian rifles were wearing out for the bullets upset easily and they made a ghastly wound. It was frequent to see the wound of entrance a mere slit, but the wound of exit would present a terrible avulsion of tissue of the dum dum type, such as a tumbling or upset bullet will oftentimes inflict. In the severe winter fighting of that zone, it was not uncommon for the soldiery to reach the forward base hospital four to six days after injury, without having had their clothes off for a month. They were caked with dirt and excrement and alive with the vermin of the

Russian trenches. Naturally under such conditions septic infection, was the rule and secondary hemorrhage was common, yet the stinking putrefactive infections and the tetanus and gas phlegmon of the West front were rarities. Even through the preceding summer, the soil of the East front has proved far less deadly than the lighly manured soil of France.

Of the inevitable lesions of war, I shall not speak in detail. Of these the saddest mutilations were by frost-bite, for the soldiers came down out of the Carpathians by the train load, oftentimes gangrenous to the wrist and knee sometimes both forearms and both legs completely frozen for the wounded men had lain crumpled in the zero snow of that bitter war zone. The blinded and paralyzed also made a tragic group. There were to be seen among the hundred thousand or more wounded to whom I have had access, a few types of the excessively rare bayonet wounds and many miracles such as brain wounds without symptoms, shot from every conceivable angle, also wounds of the mid chest, the mid belly and the heart with recovery. One illustrative case I saw at Heidelberg with Professor Frankel of Baden. He was a French prisoner apparently happy and certainly well cared for in a ward with 60 Germans. He had been shot six months previously by a rifle bullet through the left chest. Orientation and an X-ray showed the bullet tract directly through the heart from the left costal cartilage of the fourth rib in front, to the exit at the eighth rib behind. The mitral valve of the heart was leaking badly, but the man's circulation had gradually regained compensation. A companion case was shot through the identical place in the left chest. The bullet missed his heart, for the heart was on his right side, shown by radiograph to be accompanied by complete congenital transposition of his other viscera.

Neither have I the time to recount at length some of the unusual mechanical and physical features of war injuries as I saw them and heard them from officers of the battle line, such effect as the intensely destructive explosive and pulpifying effects and the suction

drag of the high powered rifle bullet at short range on brain and abdominal viscera, or such weird lesions as the production of acute caisson disease from sudden immersion in the vacuum which follows the explosion of a large shell. These and many other inevitable injuries of theoretical interest are merely touched on, as I wish to speak in the main only of those preventable lesions against which I am convinced the military plan and organization of this nation should prepare.

Broadly speaking, the surgery of war is the surgery of the infected wound.

CHARACTER OF THE SURGERY—ACUTE STAGE

The technical surgery of the recent wound in this war was crude, the instruments employed were few. Usually for some days or until a base hospital was reached the only routine was protective. The splints, traction and wound protection were the same as we use in peace. The routine of superficial iodine and the first aid packet proved grievous disappointments in inhibiting the development of infection, largely because of infectious detritus deep in the average wound. On the West front, tetanus prophylaxis as a routine was a life-saving measure of inestimable value. On the East front, tetanus was a rarity and the antitoxin was employed only curatively by spinal injection.

The average operation at the forward base hospitals consisted of opening the missile tract for wider drainage exploring it gently with the gloved finger and blunt spoon for foreign body, then iodizing the wound and packing it wide open with embalming fluid. The best wound embalming substance I observed was phenolized camphor, the Chlumsky solution we use in the surgery of peace. This inhibited the putrefaction of the lacerated infected wounds without the caustic action of crude phenol or chlorine which was occasionally employed, and more efficient than iodoform. However much it hurts one's pride to return to the days of strong antiseptics, yet it was certainly life-saving. For established infection, particularly the gas phlegmon, wide incision and wide open packing was the basis of all treatment. It was tragically impressive what trifling

lesions, when overlooked, could cause death by phlegmon and tetanus

On the West front in the base hospitals we neglected no recent wound no matter how trivial. Of the recent cases all except the through and-through clean rifle wounds were opened for drainage and removal of detritus. Even these wounds would in my opinion have fared better in the average with the skin opening enlarged. In the primitive moves of the surgery we found ourselves returning to the procedures of the Napoleonic wars. Only the refinements of the gloved finger and sterile dressing made the incalculable difference in results.

Amputation by shell was common, but amputation by the surgeon was a rarity. It was the policy both in France and Germany and particularly in Austria, to hold an injured limb sacred while there was the slightest hope. The results of conservative surgery which I saw certainly warranted that policy.

In the surgery of the recently wounded there was no opportunity for the highly technical operations of our civilian hospitals. The lacerated infected wounds did not permit of refined plastic or bone surgery, nor blood-vessel and nerve anastomosis. These operations belong to a stage months later when the wounds have healed. Missiles in the brain and chest were in the average best left alone until symptoms arose. Wounds in the mid chest and mid belly, such few as live to reach the field hospital, were sorted out at the front and sent to the ward for the hopelessly wounded. Personally, I saw no coelotomies for acute wounds and I heard of few. The military organization of the front is for the average case. It cannot support the equipment, nor do the results warrant the routine resection of intestines and other highly technical forlorn hope operative procedures. Of course a few resurrections took place in the death wards, and in the aggregate I saw many cases with old wounds of the mid head and a few in the mid belly.

The real surgery of the acute stage of war, therefore, deals with the prevention and treatment of infection. It seemed to be as primitive as the surgery of our city outpatient

department service, yet like that surgery it called for the widest experience and highest type of surgical judgment. If a nation is to be saved from irreparable loss, thus acute crude surgery of the forward base hospital must be organized and guided by the nation's highest talent. For this contingency our own nation is practically unorganized. Neither are the civilian surgeons sorted to their place, nor does the equipment exist to throw an efficient series of units where the need may be pressing.

CHARACTER OF SURGERY—CHRONIC STAGE

An important phase of war surgery is reached when the wounds enter the chronic stage. National economy is then the one thought. Both France and the Central Nations were under severe economic strain. Austria particularly was loaded with wounded for through the first year of the war more than we of the Western world can realize, the real fighting of the Central Nations for their life had been in the East. It was imperative that the soldier be returned to military or civil usefulness at the earliest possible moment. A million hospital days saved might be vital to the nation's life, therefore, the highest technical skill in every line of civil surgery was brought to bear. The masters of sanitation of internal medicine, and of surgery were made consultants of large army zones. Thus the general policy of treatment and aftercare in that zone was kept to one efficient standard.

I have not time to speak of the apparently trivial things of this chronic stage, such as the encouragement of epithelium across a wound, the healing of a sinus, the loosening of a stiff joint, the prevention of contracture in muscle and nerve lesions, yet these details make up a large part of the war surgery of the rear and in the aggregate are of the highest national importance. Each day lost in a hospital is a day of national service wasted.

ILLUSTRATIONS OF ORGANIZATION

It was an impressive lesson to me how highly organized and specialized the nation must be in time of peace to yield the desired

results under the strain and disorganization of war. In systematized efficiency of sanitary service Germany easily leads. Although apparently the individual German surgeon was no more efficient than our own, yet the results of their perfect organization put to shame the barbarity of the sanitary administration of our own last war. England for a time was prodigal like ourselves. France, although sorely beset, made a brilliant recovery in her sanitary as in her military operations. Yet from the start the German sanitary service alone in forethought, in humane, and economic efficiency, was to my mind the pattern of what organization should be. Not only in the immediate surgery, but in the specialized aftercare and return of the wounded to military or civil usefulness at the earliest possible moment, her organization was a marvel to behold. It ran smoothly with no waste motion. It provided with forethought and elaboration for every detail. It was administered with rigid economy, yet with high intelligence and in so far as I saw with kindly human interest and impartiality toward friend and foe.

To illustrate the carefully organized interior organization of Germany, the town of Heidelberg will serve as a minor example of the many I saw. This sanitary organization was under the charge of a college professor, Professor Weber of the Chair of Political Economy at the Heidelberg University.

Within ten days from the declaration of war, the trolley lines in Heidelberg had been extended alongside the railroad tracks of a large freight yard. A series of receiving wards and shelter huts had sprung up over night. They were manned by civilian organization. As the hospital trains pulled in, these were met by the ambulance trolley cars. The wounded were administered to and distributed by street railway to the various hospital units through the town. These units were specialized to take care of certain groups of cases. The seriously wounded crowded the pre-existing hospitals, the less serious were distributed in the schools and public buildings, and the minor injuries to the nursing homes. After several months

when the chronic stage of wound surgery was entered by these centers in the valley of the Rhine, the necessity for further specialization had all been foreseen and met. For example, the amputated cases were grouped together. The men were taught to batten their stumps by usage, so that no time might be wasted in tolerating artificial limbs. The crippled were taught new trades in manual training schools. Through Germany 26 such schools were established as also in France at a later period. The training was highly specialized to fit the infirmity. For instance, at Heidelberg there were a number of men who had lost their right arm, and they were receiving instructions from a similarly crippled teacher. They were first taught how to feed and dress themselves, next how to write with their left hand, and finally stenography and typewriting. A good illustration of the national economy this system effected, was the case of an intelligent farm laborer whose right arm had been shot away. Six weeks from the time he entered the training school he received employment as a stenographer at twice the salary he earned before the war. The various factories and industries of Germany were catalogued as to how many of a particular type of maimed men they could utilize. Thus in April, the German branch of the Western Electric Company had already received eleven out of the twenty-five legless workmen for whom they had promised employment. The stiffened joints and contracted scar cases were assembled and treated in hydro and mechanico therapeutic institutions. I remember well a sergeant with merely a stiffened wrist and small sinus. His wrist was cupped twice daily. It was roasted in hot sterilized sand, alternating with sun baths on bright days. It was exercised in mechanical apparatus and massaged as if the nation's life depended on that one wrist. Special schools for the blind were established when need first arose.

No day of usefulness for national betterment was lost during the convalescent stage. The convalescent wounded of the average hospital, instead of idling, smoking, and joking the entire day as when I was in France, were given instructions in arithmetic and

geography, lessons in conversational French and in German grammar and practical illustrations in the pruning and grafting of trees and vines, in the dividing of potatoes for planting and multitudinous other activities. At the larger hospital centers, the groups were even more specialized. The head wounds from the German West front were largely gathered in Cologne under Professor Preysing. The mandible cases were concentrated at Dusseldorf under a master orthodontist, Professor Bruhn. In this clinic reconstructive surgery after the terrible face injuries reached its highest development under a surgeon already trained in the accident service of the Essen Iron Works.

In Berlin the nerve lesions were collected at Virchow hospital under Bourehardt and Oppenheim. There seemed time and energy in the nation even to make elaborate color drawings of the lesions and minutely record the scientific data for future report. Down the East front of the German army, the same orderly grouping prevailed, under crude conditions, however. Austria and Hungary had recovered from their early inundation with sick and wounded. They were vast hospital camps which made the Western situation small in comparison and like the other nations these lacked the detail organization of Germany.

In retrospect of all the marvels of intricate organization, the most impressive feature was the economic results. The acute cases were less severe by virtue of prompt treatment. The chronic cases were not backing up, like logs in a jam, to be cleared out after the war. Each case was moving smoothly to its final cure, with the system and precision of peace. It was the economic, humanitarian, impersonal triumph of organization.

CONCLUSION AND SUMMARY

Thus of the nations I saw, it had taken the surgically best prepared about two weeks to bring order out of the first chaos of war, and the least prepared about half a year. For the chronic stage of wound repair only one nation impressed me as having become thoroughly organized and efficient in detail within the first half year.

From the start all these nations were infinitely better prepared for conflict than America. In our own recent war we never approached order or efficiency. We are now materially no better prepared. It is true we have a highly efficient small army medical corps, yet the professional military surgeon does not practice the surgery of war. He is primarily a sanitary officer, whose first duty is to keep the health of the troops, a second duty that of administration, and a third duty that of ridding the field army of sick and wounded. With us as in Europe, the burden of care will fall on the civilian surgeons represented here tonight. Life and limb must be conserved from infection by the civilian surgeon of the forward base hospital. America has an abundance of civilian surgeons skilled in the traumatic surgery of peace. Yet under the strain of war, in our present state of unpreparedness we cannot mobilize this raw material with efficiency. The master surgeons will be misfitted to the general needs. They cannot besuddenly mustered nor thrown well equipped to the points of vital necessity. They will lack an adequate staff of nurses and hospital personnel. They will find themselves as did our unit in France, wasting precious months in gathering the equipment and personnel for a forward base hospital, which for efficiency should have been put in operation over night.

We who have seen the nature and inhumane operation in war, of deficient preliminary organization, urge the need of preparedness on this the Clinical Congress of Surgeons. We urge that this great body impressively represent the need of surgical preparedness to our national government, to urge that we, the surgeons who must do the work of war, be organized and equipped before the storm, to plead that our organization and equipment for the first shock of conflict be no less efficient than the minimal needs shown in this great conflagration.

In urging that we pattern an adequate and complete sanitary service after the humanities of the most efficient nation, I am not pleading the cause of any belligerent. I am pleading the cause of our own country.

Tonight is part of the square issue, pre-

paredness If conflict comes shall we by lack of organization again condemn our wounded to the horrors of neglect as in previous wars; shall we maim and slaughter them by infections

more deadly than the enemies' bullet: shall we strain our national resource in life, in money, and in pension roll, or shall we be surgically prepared?

THE UNIT PLAN OF ORGANIZATION OF THE MEDICAL RESERVE CORPS OF THE U. S. A. FOR SERVICE IN BASE HOSPITALS¹

By G. W. CRILL, M.D., F.A.C.S., CLEVELAND, OHIO

IN civil practice in hospitals it is well known that mediocrity well organized is more efficient than brilliancy combined with strife and discord. A group of weaklings pulling in the same direction yield a better net result than giants pulling in opposite directions—and therein lies the strength of organization for any purpose.

A war falls like a thunderbolt from the blue—a large army is mobilized, and, prepared or not, it must throw itself against an invading foe which may be armed to the teeth and highly organized. Our country has vast supplies of untrained men and of raw materials. Our manufacturers are now learning how to make munitions, but our human material still remains raw. This is neither the place nor the time, however, to discuss our national defense from the military point of view, but rather to consider the medical aspect of our preparedness for war.

When our distinguished American Ambassador, the Hon. Myron T. Herrick, asked me to take a service in the American Ambulance I suggested that it might be better to form a Unit among the men at Lakeside Hospital, and take complete charge of a given number of patients. This proposal was cabled to the American Ambulance and a favorable reply returned. This was the beginning of the University Unit plan of organization for service at the American Ambulance.

This plan worked out so excellently in France that it has occurred to me that, at least for the base hospitals, it would be a workable plan for our American Medical Reserve Corps. After an informal discussion with the Surgeon General of the Army

he suggested that to stimulate further discussion I should outline a plan for a unit to take charge of a 500 bed base hospital. The purpose of presenting this matter before this audience is to invoke thought and discussion and to receive suggestions.

The experience of some of the nations now at war should serve as a solemn warning to us to see that injured soldiers do not lose their lives or their limbs for want of competent surgeons. Because of lack of preparation for the present emergency in Europe, it happened, in the early stages of the conflict at least, that the surgeon was more dangerous than the enemy. For us this danger may in large measure be obviated if we make an adequate organization in times of peace.

In making such an organization of the Medical Reserve Corps, we must be guided by three fundamental principles. *First*, each man should be assigned to the service for which he is best qualified. *Second*, the mobilization of the Reserve Corps should be country wide. *Third*, standard materials should be stored so that we may not be caught by a shortage at a time when industries are paralyzed.

In general, it would seem that the civil surgeons of the Reserve Corps should undertake no administrative duty—such as care of transportation, records, supplies, commissary, etc. The civil surgeon should be *primarily* and if possible *exclusively* engaged in the care of patients. These units will be most efficient if they are made up of men who have had similar training and who know each other well, and if they have associated with them a nursing staff familiar with their methods. This suggests that the first units be

¹ Presented in the Symposium on "Military Surgery," Clinical Congress of Surgeons of North America, October 25-30, 1915.

made up from the staffs of large well-organized hospitals—especially teaching hospitals—and that they be distributed according to population among the states of the union. If not already enrolled, the surgeon accepting this service should receive appointment in the Medical Reserve Corps.

The following personnel is suggested as adequate for each base hospital of 500 beds:

Surgeons:

One chief surgeon, in charge

Five associate surgeons, each in charge of one service of 100 beds

Three assistant surgeons

Orthopedic surgeon

Anesthetists, 3

Pathologist and assistant

Internist

Neurologist

Oculist

Dentists, 2

Röntgenologists, 2.

Mechanicians, 2

Secretary and Record Clerk.

Stenographers, 2.

Nurses, 50

The general surgical instruments and a supply of apparatus for each unit should be owned by the government and stored in a room set aside for that purpose. There should be meetings of the unit annually or oftener.

Each unit would be assigned to service in a certain contingent of the army and would go on duty automatically with that contingent.

The preparation and construction of the base hospitals would be in charge of the regular army. Army officers would be on duty in each hospital and would have entire charge of its administration.

THE RADICAL OPERATION FOR CARCINOMA OF THE UTERUS¹

By HOWARD CANNING TAYLOR, M.D., F.A.C.S., NEW YORK

IF we except certain superficial growths of a low degree of malignancy, there is no cure for cancer which is accepted by the profession other than its complete removal by surgical means. Though there have been promising results reported from the use of other agents, such as radium, X-rays, and the cautery, these results are not such that their use would be advised for a limited growth in a patient constitutionally suited for an operation for its removal. I personally believe that there is a distinct value in the use of radium, X-rays, and the cautery in cancer of the uterus. The use of them is still experimental, and sufficient time has not yet elapsed to prove the permanency of the results reported from their use. It is probable that some cases treated by these agents will remain cured beyond the five year period, the number of these cases, however, is uncertain, and until more definite clinical statistics are available the use of radium, X-rays, and the cautery will be largely limited to inoperable cases, and the earlier cases will be treated by some operation for the removal of the growth. If this were a test between the two methods of treatment of cancer, it would obviously be unfair as the favorable cases would receive one form of treatment and the unfavorable cases the other. The surgical removal of cancer is a mode of treatment about which we have definite knowledge, and it is not to be abandoned until we have something that is certainly better with which to replace it.

There is no doubt that the use of radium and X-rays has modified the selection of cases suitable for operation. The possibility of helping a woman otherwise hopelessly diseased has induced us to operate on cases in which the chance of relief was slight. Thus has affected badly the statistics both of the primary mortality and of the permanent cures. I prefer now to recommend radium and X-rays in such cases in which formerly I would have chanced operation.

Selection of route. Of the two routes, the abdominal and vaginal, the former is the first choice of most operators. There are, however, certain cases that are approached more easily through the vagina than through the abdomen, on account of the size of the vagina and the thickness of the abdominal wall. The larger the vagina and the greater the degree of prolapse, the more easy is a vaginal hysterectomy; but an abdominal hysterectomy is also easy in these cases because a uterus that will come down into the vagina can also easily be drawn so high into the abdomen that its removal from above is also more easy. A fat abdominal wall adds greatly to the difficulty of any abdominal operation and is a contra indication for a radical abdominal hysterectomy. If there is a combination of a thick abdominal wall and a wide vagina with a prolapsed uterus, the vaginal route should be selected. Personally, I prefer the abdominal route and use it for all cases except those in which there is a fat abdominal wall and a wide vagina.

Selection of operation. We commonly speak of a simple and a radical abdominal hysterectomy for carcinoma of the uterus. This raises the question, What is the difference between the operations? Theoretically there is a great difference, practically one merges into the other. In one operation vessels are ligated close to the uterus and no attempt is made to remove any of the pelvic connective tissue, in the other operation the ureters are exposed, the vessels are ligated outside of the ureters close to the pelvic wall, and a large amount of pelvic connective tissue and a large portion of the vagina, is removed. Practically, in some cases, because of technical difficulties, because of hæmorrhage which is difficult to control and the general condition of the patient, the theoretical operation ends with the removal of the uterus and a comparatively small amount of surrounding connective tissue. Practically, no one at the present time doing a simple abdominal hys-

¹Presented in the symposium on "Cancer of the Uterus" at the meeting of the Clinical Congress of Surgeons of North America Boston, October 16, 1915.

terectomy for cancer of the uterus would ligate the vessels closer to the uterus than is technically necessary. I know that, in my own work, my simple hysterectomies for cancer of the uterus are more extensive than they were before I became familiar with the more radical operation. I believe that this improvement in simple hysterectomies is one of the advantages that has resulted from the introduction of the radical operation. In favorable cases the theoretical radical abdominal hysterectomy can be performed and a large amount of pelvic connective tissue of the vagina can be removed. This adds greatly to the chances of a permanent cure of the case. There is no doubt, however, for the reasons that I have given, that any series of radical abdominal hysterectomies contains cases that do not differ in the amount of tissue removed from cases in a series of simple hysterectomies by the same operator.

The extent of the operation performed for the removal of any malignant growth is limited by two factors (1) the risk to the life, and (2) the amount of mutilation of the patient.

In deciding between a simple and a radical abdominal hysterectomy for cancer of the uterus the question of mutilation can be ignored because the uterus, tubes, ovaries, and a part of the vagina are removed in each operation, and the additional pelvic tissue and vagina removed in the more extended operation is practically no additional mutilation. There is, however, a distinct increase in the risk to the patient in the radical operation. It is a more extensive operation requiring more time, complications during and after the operation are more frequent, and a higher primary mortality is a necessary result.

Primary mortality The radical operation is associated with a greater risk than the simple hysterectomy. The higher primary mortality of the radical operation is not due entirely to the operation itself. It must be remembered that every series of radical abdominal hysterectomies contains cases that were too far advanced for removal by a simple hysterectomy. For a simple hysterectomy the growth must practically be limited to the

uterus itself, while a moderate involvement of the broad ligaments is not an absolute contra-indication to the radical operation. For growths of the same extent in patients in whom the radical operation is not contra-indicated because of constitutional disease or of thick abdominal wall, I believe that the primary operative risk is only moderately greater for the radical than for the simple hysterectomy and is not sufficient to outweigh the advantages of the more extended operation. After the ureters have been isolated, a procedure that is usually not difficult, the radical operation can often be done with little more trouble than the simple hysterectomy. In my own cases, the primary mortality was about 15 per cent. Some of these deaths resulted from operating on cases that were really inoperable because of the advanced state of the disease. I believe that the mortality will be less in the future with a more careful selection of cases.

The complications are more frequent both during and after a radical than a simple hysterectomy. Like the increased primary mortality they result partly from the nature of the operation, and partly from the greater extent of the growth that is attacked by the radical operation.

Injuries to the ureters They are accidental division, ligation, and sloughing. I have accidentally divided the ureter once in about fifty cases, but so far as I know, I have not ligated it. These accidents are reported by many operators, and while they cannot be laid to carelessness they are accidents that should be avoided. I do not believe that the ureters are accidentally divided or ligated as frequently in the radical as in the simple hysterectomy, and it is surely discovered in the former but may not be in the latter. Since I began to do the radical operation for cancer of the cervix uteri I have so frequently found the ureter in a relation to the uterus that I did not expect that it seemed as though I would have ligated it if I were doing a simple hysterectomy. I have no doubt that this accident occurs in simple hysterectomies for carcinoma and is never discovered.

Sloughing or necrosis of the ureters is an accident of the radical operation which never

occurs in a simple hysterectomy. In a series of 500 cases reported by Wertheim there was sloughing of the ureters in 30 cases; in 5 it occurred in both ureters. The sloughing of the ureter usually occurs between the seventh and the tenth day. The necrosis of the ureter may be partial or complete, that is, only a part or the whole of the ureteral wall may be destroyed.

The most frequent result of the necrosis is a ureterovaginal fistula, and if partial it usually heals spontaneously. In a few cases the urine may be discharged through the abdominal wound. The ureteral fistula predisposes to renal infection.

The cause of the necrosis of the ureter in most cases is probably the interference with its blood supply during the operation. It may be caused by kinking or by pressure of gauze or drainage tubes. It is possible that some cases of ureteral fistula result from a direct injury or ligation at the operation which was not recognized at the time.

Bladder complications. There is no doubt that injuries to the bladder more frequently follow the radical than the simple hysterectomy. However, I believe this to be the result of the extent of the disease and not to the intrinsic difficulties of the operation. The separation of the bladder is more extensive in the radical than in the simple operation, but if the malignant growth has not involved the bladder wall, its separation is not usually followed by injury or necrosis. As I have stated, I do not believe that injury at the time of operation or subsequent necrosis of the bladder is materially more frequent with the extended than with the simple hysterectomy.

Paralysis of the bladder requiring prolonged catheterization is of frequent occurrence after the radical operation. Catheterization for a period of three weeks or until the patient is out of bed is common. As a result partly of the prolonged catheterization and partly of the extensive separation of the bladder wall, a severe cystitis often develops.

Kidney complications. These complications are the ones that result indirectly from the lesions of the bladder and the ureters. The longer a ureteral fistula persists, the

greater are the chances of renal infection from it. A pyelonephritis necessitating a nephrectomy developed in one of my cases in which the ureter was divided during the operation and in which a ureteral fistula subsequently developed. An infection of the kidney frequently follows the infection of the bladder. This ascending infection is favored by the condition of the ureters. As the ureters are dissected free during the operation, they must subsequently lie in a bed of adhesions, and it is fair to assume that there may be some interference with their function. To the same extent that the lesions of the bladder and ureter are more frequent in the extended operation, the renal complications will be more common.

In one of my cases there was such an extensive post operative bleeding into the bladder that it was necessary to wash out the blood clots for several successive days through a large catheter. The local and general condition of the patient at the time precluded a cystoscopic examination. One made subsequently did not reveal the cause of the bleeding. It was not from a bladder extension. It was the only case in which this complication occurred.

Hæmorrhage. Bleeding that may be exceedingly difficult to control occurs from the venous sinuses around the ureters and the base of the bladder. The ligation of the anterior trunk of the internal iliac arteries will diminish the amount of the bleeding. Hæmorrhage, however, is a serious complication and is responsible for a number of deaths. The longer time that it requires to perform the radical operation and the technical difficulties associated with it often increases the amount of blood that is lost and has a definite effect on the outcome.

Infection. It is probable that the risk of infection is no greater in the radical than in the simple hysterectomy for a carcinoma of the cervix uteri of the same extent. The same care should be taken in each operation to prepare the vagina, and the extent of the disease influences the degree to which it can be rendered sterile. The larger amount of tissue that is removed in the radical operation lessens the chance of tearing the uterus from

the vagina and infecting the peritoneal wound. The larger amount of vagina that is removed in the radical operation allows greater protection of the peritoneum than is possible with the lesser operation. If the growth is a limited one, such as could be removed by a simple hysterectomy, it is possible to protect the tissues so that there is little risk of infection. In the radical operation there is an extensive exposure of the pelvic tissue, and in an extensive case it is difficult to have the technique so perfect that the tissue is not soiled during the operation. The risk of infection is certainly a great one in the radical operation. This is shown by the fact that 3 cases out of 8 deaths in my cases died of infection.

In addition to the complications of which I have spoken, there are a number of others common to all extensive operations, such as pulmonary and cerebral embolisms, pneumonia, uræmia etc., that cause a number of deaths.

A radical abdominal hysterectomy for cancer of the cervix uteri, therefore, must be recognized as an operation that is associated in certain cases with complications that seriously endanger the life of the patient, and it is justifiable only if the results are better than with any other known method.

Results Statistical and theoretical evidence favor the radical operation. From European clinics, large series of cases are reported showing a much higher percentage of permanent cures than has been obtained by any other operation. The experience of any one surgeon in America is more limited than that of some foreign clinics, but in the aggregate it seems to confirm the reports from abroad.

To me, the theoretical consideration of the operation is even more convincing than the statistical. The more extensive an operation is for a malignant growth, the greater are the chances of a permanent cure if the patient survives the operation. This is true of cancer in the uterus as in other organs, and as the radical is more extensive than the simple hysterectomy, the permanent cures must be greater.

It must constantly be remembered that it is an extensive operation associated with serious complications and a definite operative risk, and for this reason the radical hysterectomy should be selected for patients whose physical condition warrants an extensive operation and whose local condition warrants the belief that the growth can be removed without technical difficulties.

CONCLUSIONS

My treatment of carcinoma of the cervix uteri then is as follows:

- 1 For the favorable case, that is, a patient in a good general condition, an abdominal wall without an excess of fat, and no associated pelvic lesion to increase the operative risk, and a limited growth I advise the radical operation.

- 2 For a limited growth in a patient who is a bad risk on account of general or local conditions I advise usually a simple abdominal hysterectomy, occasionally a vaginal hysterectomy.

- 3 For the so called inoperable case, I advise radium, X-rays, and the cautery. In this class, because of the favorable reports that are published following the use of radium, X rays, and the cautery, I include cases that formerly I submitted to operation.

THE RELATIVE MERITS OF THE OPERATIONS FOR CANCER OF THE UTERUS¹

By DONALD C. BALFOUR, M.D., F.A.C.S., ROCHESTER, MINNESOTA

From the Mayo Clinic

THE best operation for cancer of the uterus is the one which permits the widest extirpation of the disease, commensurate with the lowest possible operative mortality, and the minimization of immediate and late complications. Unfortunately, no one operation has proved so satisfactory, either in primary or ultimate results, as to leave the treatment of cancer of the uterus on a settled basis. Certain peculiar features of cancer of the uterus and particularly of the cervix, in relation to symptomatology, variability in malignancy, and the rôle played by infection renders important the intelligent utilization of every known means to combat the disease.

Unless further evidence is more convincing, it is safe to assert that, regardless of the efficiency of any treatment of the cancer *in situ*, an organ in which cancer has developed should be removed, if such organ is of itself not essential to life. There can be no logical argument that the general surgical principles accepted in the treatment of cancer in other regions should fail to be applicable to cancer of the uterus. It is true that in cancer of the cervix its anatomical relationship to the bladder, ureters, and rectum and its relative inaccessibility introduces problems which alone tend to limit efforts toward its treatment.

It is well known that with cancer in any part of the body, secondary infection is an important factor in the spread of the disease, and consequently in the immediate and end results of the operation. Malignant disease of the cervix is a good example of this septic type of cancer, statistics showing that in 40 per cent of individuals dying from cervical cancer, no evidence of metastasis is found. The infection, as shown by Rosenow, is usually streptococcic, and any surgical measure which does not at the same time sterilize the growth and the surrounding tissues is open to serious objection. A study of the results following the older types of operations for can-

cer in any septic situation shows a high relative mortality from the disease, depending as much on the degree of infection as on any other factor, and herein lies the justification for the clinical belief in the use of the actual cautery.

Much of the pessimism in regard to the earlier history of operations for cancer of the cervix was due to the fact that the disease was often disseminated as a direct result of the traumatism of the operation, not only through the vascular system and the lymphatics but by transplantation to the operative wound. Autogenous grafting as the result of mechanical injury is an important cause of recurrence and is frequently observed in cancer in various situations. This possibility must always be borne in mind in carrying out any operation for cancer. Undoubtedly recurrences have taken place, particularly in dealing with cancers of the cervix from failure to recognize this fact, the recurrence being due not to incomplete removal of the disease but rather to the engrafting of cancer-cells on cut and lacerated surfaces.

Of the various operations for cancer of the uterus, there is no doubt that total abdominal hysterectomy, as popularized by Wertheim, is the most radical surgical procedure we possess for dealing with the disease, and no method gives higher percentages of permanent cures, especially if preceded by cautery sterilization of the primary lesion. One must, however, give serious consideration to certain indisputable facts associated with this operation. The primary mortality is higher (Wertheim reports 19 per cent) than in any other method, immediate complications, such as ureteral and other fistulae, are relatively frequent (Wertheim reports 7 per cent), while late complications, such as pyonephrosis, are not rare. It is possible that this primary mortality can eventually be reduced to less than 10 per cent by im-

¹Presented in the symposium on Cancer of the Uterus at the meeting of the Clinical Congress of Surgeons of North America, Boston, October 26, 1915.

provement in surgical technique. The possibility of fistulae of the bladder, rectum, ureter, etc., can also be greatly minimized, especially if the practice is followed of completely or nearly closing the abdominal cavity and not packing the pelvis with gauze brought out through the vagina. Since we have discontinued the use of gauze in actual contact with the possibly injured ureter, or bladder, etc., fistulae have not developed.

Do the late results justify an operation which is so extensive in its glandular dissection that serious sequelae are possible, to say nothing of the initial high mortality? It would seem from our own statistics, that in the average case they do not, and that some modification of the Wertheim operation will give as good results with less risk.

A study of our statistics shows that the results of vaginal hysterectomy for cancer of the cervix by the old bloody methods seldom permanently cured the patient and that when the clamp and cautery method was introduced about fifteen years ago, there was a marked change for the better, in ultimate results, with an operative mortality well under 5 per cent. A brief description of the operation as done in our clinic may not be amiss.

The cancer, when situated in the cervix, is first destroyed by the cautery and then a dissection made with the Paquelin cautery knife through the vagina and perimetrial tissues, the separation of the bladder by gauze dissection being the only part of the operation which is not done with the cautery. If the fundus of the uterus is drawn out anteriorly before clamps are placed and the clamps applied from above down, injuries to the bladder and ureter do not occur. After removing the uterus in this manner, the tissues in the bite of the clamps and the clamps themselves are thoroughly heated. The clamps are left on 48 hours and unlocked at least ten hours before removal. The iodoform gauze which has been packed lightly into the space between the clamps is left undisturbed for six or seven days. This operation has given as good results under similar conditions as have been obtained from total abdominal hysterectomy and with a lower operative mortality.

It is especially applicable to elderly and obese patients and to those who, for any other reason, are poor surgical risks.

The development of cancer may be described as progressive transplantation into the tissues. Experimentally, it has been shown that cancer-cells are less resistant to heat than normal cells and that heat prevents successful transplantation, therefore the tissues to as great a distance as possible from the local lesion should be heated to a point which will prevent the progress of the disease. The heat must be applied slowly for at least one hour.

Percy has developed a method which derives the full value of this agent in the treatment of cancer of the cervix. I became interested in this method about two years ago and from experience in more than one hundred cases am convinced of its great value. Its essential and advantageous features are (1) the slow heating process, (2) the abdomen always open, (3) the gloved hand of an assistant in the abdomen indicating the effectiveness of the heating process, and (4) the water-cooled speculum. The method undoubtedly offers more to the patient with advanced cancer of the cervix than any treatment with which we are familiar. Its value is so definite in the advanced stages that serious consideration must be given its possibilities in the earlier stages of the disease.

Recently, in several of our cases of advanced cancer of the cervix, the Percy treatment has been accompanied by ligation of both internal iliacs. The ultimate benefits of this procedure cannot yet be foretold. Attention should be drawn to the fact that in stretching the vaginal tissues in order to use large specula, secondary carcinomatous nodules may develop in the vagina and about the vulva. This occurred in four of our cases, evidently due to transplantation into fissures produced by the stretching. We are now careful, after any operation through the vagina, to thoroughly remove any particles by irrigation and then swab out the vagina and fissures with Harrington's solution or tincture of iodine to discourage the occurrence of such unnecessary and unfortunate sequelae.

For the moderately advanced cancer of

the cervix, the advantages of a two-stage operation have gradually become apparent. First, treatment by heat (Percy method), as in the inoperable cases, and conducted as though no further operation would be necessary; second, a total abdominal hysterectomy some weeks later. It has been interesting to note that of 16 such cases operated on in our clinic, although in three cancer-cells were still present, in 13 there were no macroscopic or microscopic evidences of the original disease. Regardless of this fact, other things being equal, I believe that the uterus should be removed. Although the results following the clamp and cautery operation were relatively excellent, the two-stage operation offers distinct advantages and we are employing it more and more frequently. For cancer of the body of the uterus total abdominal hysterectomy is the operation of choice, vaginal hysterectomy being employed only when, because of the poor surgical risk, such a route possesses positive factors of safety.

In the so called "inoperable" cases, heat with ligation of the blood supply limits the progress of the disease, stops bleeding and discharge, improves the patient's health temporarily, and occasionally converts what is apparently quite a hopeless inoperable condition into an operable condition. Our experience with the Coolidge tube and with radium has not been sufficient to justify an opinion as to the permanency of cure, but in the few cases observed, extraordinary benefit has been derived.

Summary of the present status of operative procedures for cancer of the uterus in our clinic

1. Patients with cancer of the cervix not too far advanced and who are good surgical risks should be treated by thorough cautery sterilization of the local disease in the cervix, and total abdominal hysterectomy of the Wertheim type.

2. When cancer is confined to the cervix, the vaginal outlet fairly lax, and the patient is a poor surgical risk, i.e., obese, with cardio-renal disease, etc., the preferred treatment is the clamp and cautery vaginal hysterectomy.

3. In the more advanced stages of the disease if the patient is a good surgical risk the two stage operation should be done, i.e., the Percy method of tissue coagulation by heat followed after some weeks by total abdominal hysterectomy. If the patient is a poor surgical risk the Percy method should be applied but the abdominal hysterectomy should be considered on its merits in the individual case.

4. In most instances in cancer of the body of the uterus a total abdominal hysterectomy should be done. In the small minority of patients with cancer of the body of the uterus who are poor surgical risks, clamp and cautery vaginal hysterectomy may be indicated.

The foregoing observations are based on a review of 634 cases of cancer of the uterus operated on in our clinic during the past ten years. A detailed history of these with the ultimate results will be published later.

HEAT IN THE TREATMENT OF CARCINOMA OF THE UTERUS¹

By J F PERCY, M D, F A C S, GALESBURG, ILLINOIS

A MASS of cancer is destroyed when the temperature is raised to 113° F (45° C) and maintained for ten minutes. The truth of this statement is the basis for the use of a low degree of heat in operable or inoperable uterine carcinoma, or, indeed, in all forms of malignancy, where it is possible to use heat as the destructive agent.

It seems necessary to reemphasize the fact that the correct application of heat in uterine cancer is not a cautery operation.

It should be remembered that my present technique, especially the use of the low degree of heat, is a matter of development of only three years. My paper describing my experiments, and the conclusions drawn from them, was published only last year.² In the three years, I have not had a large number of cases, except of the utterly hopeless type. Of these very advanced cases, 90 per cent are operable by the application of heat.

The results in this otherwise utterly hopeless type of cases are sometimes surprisingly good. This is especially true if there are no secondary degenerative changes in the kidneys, liver, and heart. In order not to confuse the subject from the standpoint of statistics, the very advanced case of uterine carcinoma should be classed with the palliative operations only. But let me also remind you that the heat technique in its present stage of development is the only method by which a gross mass of cancer can be safely destroyed. The result of this is an immediate improvement of the patient physically. I am also convinced that the activity of the metastasis is inhibited, probably, because the destruction of the gross mass permits the natural defensive forces of the body to become more active. Another important fact that can be truthfully claimed in favor of the heat treatment is that the local recurrence, should it develop, is much less active,

as is shown by a markedly slower growth. In addition to this, the patient loses her pain, and with it the dependence on morphine. With this should also be included the disappearance of the hemorrhage and the stinking discharge, all of which brings with it a hope that life will be prolonged in comfort, and it usually is. The resulting physical and nutritional improvement of the patient, following the application of heat, permits the use of massive doses of X-ray from the Coolidge tube for attacking the small points of metastases that may exist along the iliacs and ureters, also in the rectum and vagina. So far, my experience has taught me that the X-ray, in large masses of cancer, is a dangerous form of treatment. For small masses, regardless of how deeply seated, it is of preeminent value, if used by those really trained to use it.

Of the utterly inoperable cases, the kind with a 100 per cent mortality, I have six that lived beyond the three year limit. One of them died at the end of three years, of cancer of the liver, but with a pelvis free from demonstrable cancer. Of the five remaining alive, one was operated on seven years ago, one four years ago, and the remaining three, three years ago. In none of these cases was the abdomen opened, and in all, the high degrees of heat were used. In none of these cases, also, was there any subsequent treatment with the X-ray, serums, or toxines. In the last three years, the number of cases that have come under my care, and which should be classed as cases for palliation only, have increased in number. Many of these were recurrences after a Wertheim or panhysterectomy, and with recurrences in the bladder, rectum, and pelvic fascia or vagina. In this latter type of cases, no very appreciable benefit was given. In quite a number, death was undoubtedly hastened from a resulting ascending infection of the kidneys due to opening the bladder in an attempt to destroy the cancer in its base. In this connection, it is well to remember that nephritis is also a

¹ Best methods of discouraging the activity of inoperable cancer: a study of heat in cancer. *J. Am. Med. Ass.*, 1914, lxxi, 1635.

² Presented in the Symposium on Cancer of the Uterus at the meeting of the Clinical Congress of Surgeons of North America, Boston, October 25-30, 1915.

common accompaniment of pelvic cancer, even where there has been no operation. For the purpose of statistics, too few cases, especially of the first and second degrees of involvement, have been subjected to the low degrees of heat in the three years since my experimental work taught me its value.

It may be of some interest, however, to state that I have fifteen cases of the first- and second stage type that are alive and free from recurrence, averaging two or more years after the application of the treatment. These cases were treated with the low degree of heat, the abdomen was opened, but nothing was removed except the ovaries and tubes. None of them have been treated subsequently by the X-ray. The immediate post operative results in the cases that do well are not different from the ordinary laparotomy. Since tying both internal iliac and both ovarian arteries, I have had no secondary hemorrhages.

It is only fair to state, however, that when I publish the statistics of my first hundred cases, the immediate results in the advanced cases are not going to be such as to arouse enthusiasm on the part of surgeons, much of this will be due to the fact that I have been exploring an unknown field, risking too much, perhaps, but always with the hope that if I could destroy the gross mass, the patient's natural defensive forces would take care of the present and future metastases. With increasing knowledge of what can be done with the otherwise utterly inoperable third stage case by the application of heat, possibly by making use of a two-stage operation, by better judgment and better technique in their management, and following the hospital part of the treatment with prolonged and massive doses of X ray, I am convinced that a degree of palliation will be obtained that is worth while.

If the thorough application of heat, followed by massive doses of the X-ray, will improve, in a palliative way, the terminal stages of uterine cancer, what of its use in the first- and second stage type of cases? Because of the necessary limitation of time in these evening addresses, here I can only venture the statement that I believe my ex-

perience so far with the heat method warrants the prediction that 70 per cent of the first- and second stage type of cases will be found free from cancer five years after one application of the heat. The day for the use of the cold steel knife in any form of cancer, in any stage of development, and in any part of the body, where the hot knife could just as well be used, is rapidly disappearing. I have no criticism of the surgeon who does a Wertheim or panhysterectomy. If two or three months before his hysterectomy he has thoroughly applied a low degree of heat. His operation will not only be made easier from the loosening of fixed structures by the heat, but it will therefore be made safer, but more important than all these, if the structures that he removes subsequently with the knife are subjected to complete serial section, and examined under the microscope, in many cases no cancer will be found. In other words, he has performed, possibly, a needless operation.

There are three important causes for the dissemination of cancer. The first cause is the primary use of the steel knife. The second cause is the curette; and the third is the more or less rough manipulation of the cancer-infected tissues incident to their removal. The knife and curette are a most effective mechanical stimulant and disseminator of cancer infection. If the knife is used in an attempt to eradicate cancer in the human subject, and it unfortunately comes in contact with any part of the cancer mass, no matter how remote or how small, it also acts as a mechanical stimulant, and the tumor growth is excited into new virulence in a most remarkable way. To remove a piece of suspected tissue for diagnostic purposes only, with anything but the hot knife, is a most unfortunate breach of good surgical judgment. Manipulation of the cancer growth, incident to its removal by the knife, is also a dangerous procedure, because it encourages dissemination of the growth. A small portion of cancer can be forced from its primary situation in the body of the uterus, or uterocervical junction, through the uterine wall, to rest as a free mass under the serous surface of the uterus. If this can be done as an incident to a hysterectomy,

tony for an easily recognizable mass of cancer, so that this dislodged piece can be seen with the eye after the gross specimen is removed, what of the undoubtedly easier disseminations produced by the manipulation when the lymphatics, vessels, and tissue spaces, filled with cancer-cells, are rubbed or spilled over the raw surfaces made by the steel knife during the removal of the gross mass? A mass of cancer should always be manipulated, if at all, with even more than ordinary gentleness. One of the great advantages of the heat method of destroying cancer is that practically no manipulation of the malignant growth is ever necessary. When the knife is used, manipulation of the already infected tissues and organs becomes at once one of the serious factors in establishing a recrudescence of the growth. Wherever the hot knife goes, cancer is destroyed. Wherever the cutting edge of a steel knife touches cancer it is given a new impetus to grow, and many new points of recurrence appear.

If I may venture a prediction it is this that the treatment of cancer by low degrees of heat to be followed in the advanced cases with massive doses of X ray delivered through the medium of the Coolidge tube, is to prove as soon as its merits are understood and appreciated the greatest advance so far reached in the treatment of early and late cancer.

In conclusion permit a word as to technique

1 Open the abdomen. Only by doing this can uterine cancer be safely and most effectively treated by the application of heat.

2 Use a low degree of heat. If a cauterizing temperature is used in the heating iron, a carbon core is formed in the cancer mass. This inhibits the dissemination of heat.

3 Pass the heating head through the uterocervical junction to the fundus of the uterus. Keep it in one position until the whole mass contiguous to the heating iron is made so hot that it cannot be held longer in the surgeon's hand when encased in a medium weight rubber glove.

4 Apply the heat until all the structures that were fixed at the beginning of the application are freely movable. To do less than this must of necessity, defeat the object of the treatment, i.e., the complete penetration of all the cancer infected area possible. Can this be done in every case? No! Can it be done in the majority of cases? Yes!

And finally it seems to me reasonable to assume that if one case of utterly inoperable uterine carcinoma can as reported here, be made to live without recurrence, for even seven years after the application of a certain definite technique, and another similar case is alive and clinically free from uterocervical cancer, four years and six months after the same treatment, we can at least hope for a large number of beneficial results when we fathom the full measure of the possibilities to be accomplished by the application of heat in the uterine carcinoma.

AUTOTRANSPLANTATION OF THE CORPUS LUTEUM

By JOSEPH B. DELEL, M.D., F.A.C.S., CHICAGO

TRANSPLANTATION and grafting of ovaries has been done for a great many years, Martin, Tuffier, Chalfant, and others have reported numerous cases. Sometimes the graft takes and the ovarian function is perpetuated for several years. More often the grafts are absorbed, and sooner or later the function of the ovary is lost. I desire to report two cases of auto grafting of the corpus luteum. This was done in the hope of preserving the pregnancy.

CASE 1. Mrs. G., age 27, iv para. Has had two full term children, and one abortion at 3 months. The patient complains of pain in the right ovarian region. Her last period was six weeks ago. Examination shows the uterus enlarged and pushed to the left side by a tumor about the size of an orange, occupying the right posterior quadrant of the pelvis. A diagnosis of ovarian cyst and pregnancy was made, though the suspicion was expressed that an ectopic gestation might be present. Operation revealed a right ovarian cyst and a pregnancy of eight weeks. Occupying the hilus of the ovary underneath the tumor was a large corpus luteum. I tried to remove the cyst without disturbing the corpus luteum, but failed to do so. The corpus luteum popped out of its bed like the pit out of a cherry. It was carefully preserved in a wet sponge. After the stump of the ovary was sutured a slit was made in the broad ligament and one half of the corpus luteum was pushed between the folds of the broad ligament which was then closed with a running suture.

Recovery was complete except that the patient complained of a great deal of pain on the left side of the abdomen. The graft of corpus luteum was in the right broad ligament. Four weeks after the operation hemorrhage and pain appeared and abortion became inevitable. While attempting to curette the uterus, it suddenly dilated to the size of a six months' pregnancy and filled with blood. Its walls were paralyzed although the uterine contractions had been very strong before. I feared I had punctured the uterus and to empty the organ as well as to prove the existence of a perforation, I did an anterior hysterotomy.

There was no injury to the uterine walls, but it was easy to demonstrate the paralysis of the musculature. The whole pelvic wall was palpable through the uterus, and the immense cavity was filled with blood. The ovum was free in this lake of blood and was easily extracted. The uterus was then packed

with gauze. During the suture of the hysterotomy wound the hemorrhage was very free and hard to stop, giving me the impression that it was of hemophilic nature. Coagulose was administered. The patient recovered very slowly from her anemia.

CASE 2. Mrs. K., age 28, iii para. Last period eight weeks ago. The patient complains of pain on the right side colicky in character and accompanied by nausea and faintness. These attacks have been present at intervals of two to three days for three weeks. Diagnosis was right ovarian cyst with torsion of pedicle and pregnancy, or extra uterine pregnancy. Operation twisted ovarian cyst on the right side and a pregnancy of about eight weeks. A corpus luteum was not found in either ovary. I therefore, removed that part of the right ovary containing the ovarian cyst, immediately opened the latter, and found it made up of several loculi. In one of the septa between two loculi, I discovered a corpus luteum. Of this I took one half and imbedded it in the right broad ligament in the manner of the first case.

The recovery from operation was uneventful, but about the sixth day a small amount of dark grumous blood escaped. On the twelfth day a rather severe hemorrhage occurred necessitating tamponade. On the thirteenth day the packing was removed and the ovum found hanging out of the cervix. Curettage was done.

Naturally one ought not to generalize from two cases. In the first place, it has not been proved that the corpus luteum is absolutely necessary for the continuance of pregnancy, as Frankel and Born have suggested. Cases are on record of double ovariectomy during early pregnancy in which gestation continued to term.

That it is a safe procedure from a surgical point of view, to imbed portions of corpus luteum in the broad ligament is proved in the two cases. On the next occasion in which I find it necessary to perform an operation of this kind, I will use in addition, extract of corpus luteum by mouth although we will have more complicated conditions from which to draw inferences.

Both of these women complained of nausea and vomiting for several days after operation, but this could have been due to the post-operative conditions, and one does not need to

ascribe it to the flooding of the system by the corpus luteum hormones

In neither case was the implanted body palpable in the broad ligament at the later operation, but this may have been due to accidental conditions. That there was no mass at the site of implantation is certain. Know-

ing the constitution of the corpus luteum cells one would expect them to be rapidly absorbed

LITERATURE

- MARTIN Surg., Gynec. & Obst., 1915, xvi, 563 (Gives complete lit.)
 TUFFIER Am J Obst. 1915 October
 CHAFFANT Surg., Gynec. & Obst., 1915, xxi, 579

SOME ATTEMPTS TO PRODUCE EXPERIMENTALLY CONDITIONS OF SYMPATHETICOTONUS, VAGOTONUS, AND HYPERTHYROIDISM¹

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IN the past few years, the question of the vegetative nervous system and the ductless glands has been the subject of unusually active study. More and more the important part played by these sets of organs, in physiology as well as in pathology has been properly appreciated and those investigators concerned particularly in clinical work have felt that there were strong reasons for considering these organs as a whole or as important component parts of a whole in which the regular function of every subsidiary part was extremely valuable to the health of the entire organism, while disorders might lead to a pathological condition. Abnormalities at one point might disturb the equilibrium normally existing between the sympathetic and vagus or between various groups of hormone-forming organs. Clinically such a condition would reveal itself either as an *ex ipso* more or less distinct disease (such as exophthalmic goiter), or merely in the form of less striking symptoms which on account of other simultaneous symptoms are referred to entirely different groups (such as cholelithiasis).² In view of

the very great difficulties often encountered in a proper interpretation of clinical observations, it is natural that attempts have been made to study the effect of the removal of one of the glands in question, for example, the thyroid, or of supplying the organism with a hormone or with some substance of like effect, such as adrenalin. This substance was chosen with a view as to its affinity either for the sympathetic or for the autonomic nerve system, that is, as to whether it was sympatheticonic or vagotonic. It has thus been possible to a certain extent to study either the sympatheticonic or vagotonic symptoms of diseases.

There is, however, another possible mode of producing sympatheticonic or vagotonic conditions, at least in theory. It is based on experiments, made chiefly during a period of several years, by Langley,³ in order to

¹ *Liv 122* J. Nerv. & Mental Dis. 1914, xl, 745; *Thesis* (Mittell a. d. Grenzgeb. d. Med. u. Chir.) xviii, 1914, 259; 1915, xxviii, 415; *Bull. Intern. Secretion* 1915, i, 210; and others.

² Langley's (J. of Physiol. 1904, xxxi, 185) object was chiefly to obtain "fusus nudi" (nude nerve ends), to study the physiological aspect in other words and not to touch upon the histological process. He merely wanted to get two nerve ends to grow together after culture in such a manner that the new limited nerve becomes a functioning whole replacing the original nerve communication. He regarded, as of minor importance, in this connection, the question as to how the nerve ends grow together, whether the fibers of both the proximal and distal remnants coalesce actively (the coalescence theory) or whether only the axal cylinders of the former expand peripherally (the outgrowth theory). Langley's investigations were carried on before the revealing of the all-or-none law of nerve conduction. His results of progress that resulted from not having succeeded in cultivating tissues *in vitro* and in observing directly and in detail the manner in which living cells grow are to be regretted. On this subject see Harrison (*Neue Versuche u. Beobachtungen über das Wachstum des peripherischen Nerven des Wirbeltiere*, Bonn, 1904, Anat. Rec. 1907, vii, 165). Lewis and Lewis (*Anat. Rec.* v. p. 227, 1910, p. 2, 1915, 227, 3). *Exp. Med.* 1902, xiv, 307; xvi, 421; 1913, xxviii, 424; recapitulatory articles by Cushing (Johns Hopkins Hosp. Bull. 1905, xvi, 77; 1910, xxi, 335) and E. Hirschman (*Wynne* 1914, 189; 1915).

³ With regard to the nomenclature there is not yet full agreement. Some, it is true, as subdivisions of the vegetative nervous system, are the system that innervates the cerebral and spinal nervous system, supplies the smooth muscles, glands, etc.; (1) the vagus, the autonomic system, and (2) the sympatheticonic (the sympathetic system). Some have assigned—as the advantage of this is questionable—to the whole the term vegetative or autonomic system, which latter they divide into (1) craniosacral and sacral portion, including the vagus, and (2) a thoracic part (sympatheticonic). By hormones (Bailey, Starling) are meant the chemical products secreted by the ductless glands in their regular metabolic function. See Espinasse and Hess (*Ztschr. f. klin. Med.* 1909, lxxvii, 375; 1909, lxxviii, 395), E. E. Jensen and Thorsling (*Ztschr. f. klin. Med.* 1911, lxxxi, 27). *Timine* (J. Am. M. Ass. 1915

determine the possibility of an anatomical and functional union of nerves of different kinds, by resorting to suture. Flourens¹, Forssman², Ballance,³ and others, proved that the central end of one nerve might make functional union with the peripheral end of another nerve of similar kind, for instance, the accessorius with the facialis. Langley and Anderson⁴ showed, by systematic combinations covering practically every possible variation, that such a union between the central end of one nerve and the peripheral end of another, regardless of the character of the nerves, was nearly always a possibility.

In this series of experiments Langley and Anderson performed the following operation on a cat. The phrenic and sympathetic on the left side of the animal's neck were cut. The proximal end of the former nerve was sewn to the distal end of the latter, and the proximal end of the latter to the distal end of the former. On the right side, the lower half of the cervical sympathetic was excised. The visible consequences of these steps were equal paralytic effects on the two sides of the head for about two months (in the eye a constriction of the pupil etc.) These changes then gradually diminished on the left side. After 197 days, still a difference was noticeable between the paralytic symptoms on both sides and while electrical stimulation of the left cervical sympathetic immediately below the superior ganglion produced the customary effect in the corresponding eye (dilatation of the pupil etc.) nothing resulted from a stimulation of the right cervical sympathetic. Similar experiments were made on two other cats. Langley and Anderson point out *en passant* that at no time was any change observable in the nictitating membrane, eyelids or pupil to correspond with respiration.

The last mentioned method of experiment may be of interest in quite another connection than that which Langley and Anderson had in mind. Under normal conditions the phrenic nerve is the path over which

automatic impulses constantly pass to the diaphragm. Therefore, if it were possible to transmit and, as it were, accumulate to the sympathetic nervous system, for any length of time, the stimuli which are conducted from the central nervous system to the periphery through this nerve, it might be possible also in this way through the mediation of a sympatheticotonic condition to produce changes in the organism similar to the diseased conditions that may be conjectured to be partly due to mental emotions. At any rate there would be sufficient ground for ascertaining whether an anastomosis experimentally produced and of some duration, between the central end of the phrenic and some point of the sympathetic or vagus, could result in general alterations of the organism.

A short preliminary report of an investigation of this nature has just been published by Cannon, Binger, and Fitz.⁵ They formulate the object of their investigations as follows: "Interest in the bodily changes during or following emotional excitement led us to inquire concerning the nature of certain diseases often reported as having emotional origin. We proceeded on the theory that repeated emotional experiences might lower a naturally high neurone threshold and thus result in frequent stimulation of parts which normally are only occasionally roused to special activity." In these experiments the anterior root of the phrenic on a cat "was fused with" the right sympathetic cord of the neck. Thus, after regeneration, "there was delivered to neurones in the superior cervical ganglion a volley of impulses every time the animal breathed." The first results of these experiments were made known in a lecture by Cannon late in the autumn of 1914. At that time four animals had been under observation for about five months after the nerve operations, all of which appeared now to present more or less evidence of hyperthyroidism concerning which I shall speak later.

Cannon's report was undeniably of great interest. If as he claimed it was possible to obtain through a "hyperstimulation" of

¹ Ann. d. Sc. nat. 1848 III 115 (cit. J. Physiol. 1904 XXXI 365.)

² Ziegler's Beitr. z. path. Anat. 1858 XLIV 36.

³ Lancet Lond. 1902 I 170-191.

⁴ J. of Physiol. 1907 XLII 315, 1908 XLIII 240, 1909 XLIV 439, 1909 XLV 365, 418.

⁵ Am. J. Physiol. 1915 XXXI 163.

one sympathetic brought about in the way described, the same symptoms that characterize Graves' disease in human beings, a very profitable mode of study and interpretation of this disease would thus be opened up.

At the time of Cannon's announcement, I was in Professor MacCallum's laboratory in New York (Department of Pathology, Columbia University) engaged in investigations in the same field.¹ I was, therefore, very glad to take advantage of the latter's suggestion to repeat Cannon's experiments with certain modifications—to unite in the neck the proximal end of the phrenic nerve with that portion of the sympathetic or vagus respectively that goes downward to the thorax. In order to escape as far as the vagus is concerned, the disturbing influence on the heart of a possible direct chronic irritation of the vagus fibers going to that organ, I considered it more advisable to perform the anastomosis of the nerves down in the thorax, right over the diaphragm. The technique would be somewhat complicated by this change, but it would involve the consequence of placing a greater portion of the sympathetic or autonomic nervous system in a condition of stimulation than was the case in Cannon's union of the phrenic with the part of the cervical sympathetic ascending into the head.

Therefore I performed a number of operations on the neck, in which one phrenic and one sympathetic were severed and then sewed together so that the proximal end of the former was connected with the distal end of the latter, immediately under or right at the superior cervical ganglion. Phrenic impulses of central origin would then chiefly influence the smooth muscles of the orbit and eye. I performed a second series of operations in the thorax and after cutting off the proper nerve trunks united the proximal end of the phrenic with the distal (directed toward the abdominal cavity) end of the sympathetic or vagus. A detailed report of these experiments is given at the end of this paper.

Besides the three cases discussed in the first series of cases which were operated upon on December 9, 1914, December 12, 1914, and March 5, 1915, respectively five other animals (dogs, cats, rabbits) were similarly treated. But there would be no special interest in a statement of their cases here, as they died within three weeks after the operation, without having shown any other characteristic symptoms beyond the constriction of pupil, palpebral fissure etc. which are regular signs of sympathetic paralysis. Causes of death were narcotic intoxication, pneumonia, infection post-operative hemorrhage. About 3 cm. of the sympathetic were always excised before the nerve suture was made.

Of the 14 thoracic cases in the second series of cases Nos. 1 to 6, 12 and 13 were operated on December 10 to 20, 1914, the others January 2 to April 3, 1915. In addition operations were made on five animals who died within 1 to 10 days. The cause of death in all these cases was infection following the operation. In one case the infection started from the tracheotomy wound and was combined with general emphysema. All the animals were anesthetized by intratracheal insufflation by the Meltzer-Auer method. The technique was not entirely the same for dogs as for cats. In the case of the former after general narcosis had been brought about in the regular way intubation *per os* was easy with a half rigid catheter. But with cats this method presented such great difficulties that I preferred carrying out a tracheotomy first and then inserting a tube through the tracheal wound. The tracheal wound was always closed after performing the nerve anastomosis in the thorax. Never except in the case described above did it cause any complications. The tracheotomy was usually performed in the seventh or more commonly the eighth interspace. After carefully stopping the hemorrhage in the soft parts a self-retaining retractor was inserted and its blades separated widely. The lower lobe of the lung was pushed up and kept away from the field of operation by a gauze compress. To make possible a union of the phrenic and sympathetic it was often necessary in order to mobilize a sufficiently large section of the sympathetic to cut one of the sympathetic roots. All nerve sutures were made end to end with very fine silk on a fine needle. Before closing the thoracic cavity it was in some cases filled with a physiological salt solution so that the lung subsequently might regain its normal volume with less difficulty, but the general post-operative condition of the animals showed no resulting improvement from that modification. As a rule the animals recovered quickly and seemed quite well 3 or 4 days later.

Before taking up a discussion of the various details in the report of the experiments it may be well to consider the length of time during which the animals were observed after

¹Some Attempts to Produce Parasympathetic experiments. In press.

operation, as well as the purely anatomical viewpoints of the question of regeneration at the sutured nerve-ends

Although the time clapsing between the suturing of the nerves and the carrying out of the final investigations was never very long (the shortest period, 20 days, Case 3, the longest, 175 days, Case B), for any animal, it may still, on the whole, have been long enough to enable the nerve-communication to be restored. In one of his experiments on cats, Langley¹ found that after 112 days the proximal end of the phrenic and the distal end of the sympathetic, which had been sewed together on the neck, had united so completely, that electric stimulation of the nerve proximal to the point of suture produced the customary effect of sympathetic stimulation (dilatation of the pupil, constriction of arteries in the ear, etc.) A result similar in principle was obtained by him within a month after sewing together the vagus and sympathetic on the neck.²

With regard to the healing up at the nerve suture-place in my cases I noticed as a rule, a distinct macroscopic difference, depending on the age of the nerve anastomosis. In Cases 2, 3, and 8 (84, 45, 20 and 70 days, respectively after operation), the place of suture made the impression of a callous like swelling, in Cases A, B, 4, 6, 7, 9, 10, 11 (131, 175, 107, 100, 57, 27, 87, 64, days respectively after operation), it was smooth and slim and impossible to distinguish with the naked eye. But it must be noted that in the last three cases it was with the vagus that the phrenic had been sewed (cases 9, 10, and 11), thus suggesting that these more closely related nerves are more quickly healed than when phrenic and sympathetic are united.

The fact that nerves of similar or identical nature really have a very great tendency to heal together is shown beautifully by Cases 12 and 13, 99 days or 73 days respectively after one phrenic and both vagi, or, in the other case, one phrenic, both vagi and one sympathetic had been severed, all these nerves had neatly healed except the phrenic in the former case and the sympathetic in the latter. Experimentally the same fact had been ascertained

before (Langley¹ and others). The tendency to regeneration is so strong that, as Cushing⁴ puts it, it is almost impossible to prevent some reunion of divided nerve-fibers with their original central ends, or with the central ends of fibers from other sources which were unavoidably cut through during the operation. This is all the more interesting since we have long been taught that such a reunion is not to be expected unless the fibers of a severed trunk are encouraged to find their proper connection by a surgical approximation of the stumps with suture or by some other means.

The histological examination of the place of nerve suture, which I made in some cases, led to a corroboration of the impression I had obtained with the naked eye, that the healing up of the connected nerve ends was satisfactory. This microscopical study was made of Cases 1 and 3, as well as of another case not included in the tables, which resulted in death on the day following the sewing together of the phrenicus sinister with vagus, sinister. Bielschowsky's stain gave the best picture, poorer pictures resulted from Stroebe's method and from Weigert's iron hæmatoxylin stain.⁵ Serial sections were not made and thus it was not possible to get any completely exact conception of conditions at the point of suture. Yet, on both sides of the latter were seen well stained axones which, in the phrenic and vagus, sometimes had medullary sheathes. As in Langley's observations¹ I also found that some of the axones had not grown over the place of suture and regenerated, but had lost their way in the connective-tissue growth and ended blindly.

I have still to discuss the data in the experiments as to the condition of the animals after the operations. As to this point, I have taken into consideration the changes in the general condition (weight, pulse, carbohydrate tolerance, etc.) and local symptoms (eye changes).

Have the results been of such a nature as to show, in the operated cases, a symptom-complex indicative of sympatheticotonic or vagotonic conditions, or even of hyperthyroidism? First it must be stated what

¹ J. Physiol. 1897 xxi 275

² Johns Hopkins Hosp. Bull. 1905 xvi 77

³ In staining Schmolt's description of the methods (Path. anat. Untersuchungsverfahren Leipzig 1907 p. 213) was followed

⁵ J. Physiol. 1897 xxi 215

¹ J. Physiol., 1904 xxi 365

² Cf. Timme, J. Nerv. Ment. Dis., 1914 xl 369

symptoms in dogs and cats are characteristic of the pathological conditions referred to, particularly of hyperthyroidism. A precise statement of this matter is impossible.

Graves' disease is a very unusual disease in dogs. I went through the last two annual volumes accessible to me of Ellenberger's and Schütz's *Jahresbericht über die Leistungen auf dem Gebiete der Veterinärmedizin* without finding anything on this subject. Eggers and Maury⁴ have related a case of Graves' disease in a five week old dog. The thyroid was enlarged, and (as observed at the operation, profusely supplied with vessels, the pulse was rapid 160 to 170 per minute), a fine tremor was present, but no unmistakable exophthalmos. Diagnosis was made of Graves' disease, thyroidectomy was performed, a generally good condition ensued but was of short duration. Six weeks later the dog died suddenly without reappearance of the old symptoms. The morphological aspect of the thyroid gland was that of an exophthalmic goiter.

It is particularly difficult to judge the cases of experimental Graves' disease in animals recorded in the literature. Baruch enumerated the following symptoms of Graves' disease in dogs, having observed the symptoms in a number of animals after intraperitoneal injection of freshly ground human goiter irritability nervousness extreme emaciation, falling out of hair diarrhoea tachycardia, glycosuria lymphocytosis and sometimes exophthalmos.⁵ It is not surprising that the introduction into the animal organism of a rather large quantity of heterogeneous proteid material of thyroid nature all at one time has the effect of a poison. Carlson⁶ makes the interesting statement that the same effect can be produced in rabbits rats and guinea pigs by feeding them with desiccated muscular tissue as with desiccated thyroid preparation. Under these circumstances an increase in pulse rate fever general weakness emaciation etc. may assuredly arise without assuming that a typical case of Graves' disease has been produced. The most characteristic feature about all these experiments is that experiments made by one investigator with positive results seldom give the same result when performed by another. In the few cases in which unquestionable Graves' disease symptoms are declared to have been produced, they have never remained evident for long.

The recognition of *sympatheticonic and vagotonic conditions* is just as vague or even more so. Macleod⁷ showed among other things that stimulation of the splanchnic nerve produces hyperglycemia (provided the adrenals are intact) he obtained the

same effect, after severing the plexus hepaticus, by electrical stimulation of the peripheral cross section. Pawlow, Schill, Van Yzzen Cannon, and others, observed that stimulation of the vagus resulted in increased activity of the stomach glands.⁸ And Timme⁹ ascertained a histological hyperplasia of the mucous membranes in the stomach resulting from a chronic stimulation of the vagus lasting several months (produced by applying gently a ligature around each vagus). Finally Cannon, Binger, and Fitz observed in their experiments on cats, mentioned above, the presence of a marked tachycardia, the average heart rate was 222 while in normal case 165. Besides there were loose movements of the bowels falling out of the hair, the cats were unusually excitable. Alterations of basal metabolism also occurred, the average heat loss per kilo per 24 hours in normal adult cats was 4.4 calories but in four of the experimental animals it was 66 and in one 112. The latter died sooner than the others and at the autopsy the adrenals were found to have nearly three the average weight. Finally still another symptom was mentioned dilatation of the pupil on the operated side in dim light and in one case, respiratory hippus.

It is perhaps proper here to give the division of Graves' disease symptoms into *sympatheticonic and vagotonic* according to Eppinger. The immediate source of this table is listed.¹

SYMPATHETICOTONIC GRAVES' DISEASE SYMPTOMS

- 1 Pronounced protrusion of the bulbs
- 2 Graefe absent
- 3 Loew's sign positive
- 4 Mobius positive
- 5 Dry bulbs
- 6 Greatly increased activity of the heart with less pronounced subjective symptoms
- 7 Sweating and diarrhoea absent
- 8 Falling out of hair
- 9 Eosinophilia absent
- 10 Inclination to fever
- 11 Alimentary glycosuria
- 12 Refractory behavior to pilocarpine

VAGOTONIC GRAVES' DISEASE SYMPTOMS

- 1 Relatively moderate degree of tachycardia
- 2 Pronounced subjective heart symptoms
- 3 Graefe definite
- 4 Wide lid clefts
- 5 Mobius absent
- 6 Slight protrusion of the bulbs
- 7 Increased lachrymation
- 8 Profuse sweating
- 9 Diarrhoea
- 10 Disturbances of digestion
- 11 Eosinophilia likely
- 12 Alimentary glycosuria absent
- 13 No adrenalin glycosuria
- 14 Pigmentation

¹ Struma simplex (common source seems to be frequent in dogs as well as in men. Hutchinson, *N. Brit.* (1891) has reported a case of Graves' disease in a cow. *Deutsche Thierärz. Wochenschr.* (1891) v. 1, 300). Cf. Eggers and Maury, *Ann. of Surg.* 1912, 190. (October).

² Zentrall. f. Chir. 1912 XXXIII 1185 1912 XXXV 315. Also see *Buchers Zentrall. f. Chir.* 1912 XXXI 137. Klose, *Ergebn. d. innere Med. u. Kinderch.* von Klose 1913 p. 187. Wedell, *Innere Sekretion* 1914 p. 210.

³ Wedell, *loc. cit.*

⁴ Diabetes, its Pathological Physiology 1913.

⁵ Timme, *J. Nerv. & Ment. Dis.* 1914, 41, 745.

⁶ *J. Nerv. & Ment. Dis.* 1913, 41, 311.

⁷ *Johns Hopkins Hosp. Bull.* 1914, XIV, 214.

In stating the symptoms observed in the animals in my experiments, a distinction must be made between dogs and cats. Psychological peculiarities could not be observed in any of them (except dog No. 2, who seemed to be very sensitive after operation). But the physical observation was repeated almost throughout that the dogs became leaner and the cats fatter after the operation, no matter what was done to them.¹ Yet it must be noted that such was also the case in all the animals kept in the laboratory during the same winter. I observed it, among other things, in a score of dogs in which one or more spleen-vessels had been ligated, in dogs from which one sympathetic neck ganglion had been removed or in which Eck's fistula had been made, or which had not been operated on at all, and I observed it as well in cats in which one adrenal had been removed, etc. It seems quite likely that other circumstances than those directly connected with the operation caused the difference in the conditions of nourishment. The dogs supplied to the laboratory usually presented a rather good general condition on their arrival, while the cats, on the other hand, were starved and in a bad state. But conditions in the laboratory were such that the dogs had to be kept in a place more unfavorable as to temperature, etc., than were the cats.

Another difference observed was that the dogs began to lose their hair at most two months after being brought to the laboratory and to show signs of itching and scratching. But this phenomenon also was true of all the other dogs kept in the laboratory, operated or not operated on. The cause was probably mange, which I am informed by colleagues is a rather common thing in such laboratory animals.

The pulse rate was never very high. It was always taken at about the same hour in the morning, the hand being placed on the animal's heart and the beats being counted

for a whole minute. The average rate for dogs was about 120—lowest 97, highest 133—21 observations in all; for cats about 130—lowest 113, highest 141, 41 observations in all. Three cats had an average rate varying between 132 and 162 before the operation (6 counts) and 2 of these (Nos. 8 and 11) varied between 135 and 141 during the days immediately following operation (6 counts) and between 142 and 149 during a couple of days, two months after the operation (10 counts).

For purposes of comparison the following counts made on other dogs during the same period may be mentioned.

In a dog the upper half of whose spleen had been ligated a month ago, the heart rate had an average of 110 (3 counts), in another 108 (2 counts). The corresponding figure for a dog whose upper sympathetic neck ganglion had been gently ligated two months before was 102 (2 counts).² It was 112 (4 counts) for another dog, whose two ovaries as well as the upper sympathetic neck ganglion had been removed three weeks earlier and who at the time of the pulse counts was fed on a total of 8 gms. thyroid extract in two days. A dog which had undergone ovariectomy on both sides six weeks previously and which during the period of the pulse counts received 2 to 5 gms. of thyroid extract daily had an average rate of 117 (16 counts). Finally, the figure was 146 (27 counts) for a dog whose ovaries and one sympathetic neck ganglion had been removed and then fed on 2 to 3 gms. thyroid extract daily for two weeks after which she received 25 gms. fresh human colloid goiter grafted intraperitoneally. After the graft the heart rate of this animal rose quickly and considerably and reached on one day 198 (the highest I have ever observed in any dog).³

The fluctuations in pulse rate in these animals coincided, yet with still great variation, with another change, that in the carbohydrate metabolism.

It is well known clinically that patients with Graves' disease sometimes develop glycosuria. It has also been found that this symptom may be produced in animals or human beings by administering thyroid products (the dogs just mentioned, one of

¹ Another fact about the dog that may be of a certain interest in view of what is reported later in the paper is that his tolerance for saccharose was under 5.

² Another fact worth noting about this dog was the changes in weight and loss of hair. As long as the animal was kept (in a separate cage) on the same room with the cats the weight remained fairly constant and no loss of hair was observed. But when she was placed (about 3½ weeks later) in a somewhat colder place together with all the other dogs a pronounced emaciation set in accompanied by loss of hair.

³ Exceptions were the cats C and 15. The former became very lean and developed a constant deterioration in general condition. Yet there was a distinct explanation in the post-operative infection that led to death. The necropsy was found at the autopsy to have been broken. The other cat was quite well during the first 4 weeks following the operation then like the other animals, at that time living in the same room she was struck by a severe infection giving symptoms particularly from the respiratory organs.

which I fed on thyroid extract and in the other of which was grafted human colloid goiter intraperitoneally, had during the time in question, sugar in their urine) Crowe and Wislocki¹ found that the removal of one adrenal, either one, causes temporary glycosuria. Macleod's observations of the same symptom after stimulation of the splanchnic nerve has already been mentioned. Thus it is evident—surely could more examples be given—that the endocrine organs do have an influence on the metabolism of carbohydrates an influence whose mode of action is extremely complicated and by no means plainly understood.

Aside from the qualitative test for sugar in the urine the simplest way of detecting possible irregularities in the metabolism is probably the determination of the limit of assimilation of the organism for a certain kind of sugar. This limit is said to be reached when the sugar administered *per os* leaves it with the urine. In healthy human beings this limit—the sugar tolerance—is pretty high though nevertheless subject to individual variations. Data on sugar tolerance in animals are found in the literature but differ considerably. According to Hoppe Seyler² it amounts, for saccharose in normal dogs to 20 to 30 gms, according to Loetsch, Cushing and Jacobson³ to 10 gms per kilo body weight when sugar is introduced *per os*.

In my animals I tried to determine whether the nerve operations performed might have any influence on the sugar tolerance. A study of the experiments will show that no decisive indication is obtainable, either with regard to the place or the mode of the nerve anastomosis or to the length of the period elapsing after the operation.

For the sake of brevity I have here given simple numerical data on the sugar tolerance. The fact that an animal weighing 1 kg is able to consume 10 gms pure saccharose dissolved in water with a little milk without the urine's giving a positive sugar reaction next day I thus indicate by saying that its sugar tolerance is more than 10. But if the same animal conditions otherwise remaining unchanged after consuming 15 gms of saccharose shows sugar in the urine I state this by saying that

its sugar tolerance is between 15 and 10 etc. As reagents I used both Nylander's and Benedict's solutions in each test. An uncertain result with the latter I call negative (Benedict's reaction is possibly somewhat more sensitive than Nylander's).⁴ Saccharose was chosen for the test, partly because if the animals drooled into the cages after the administration of the sugar, there would be no danger of contamination of the urine by a reducing substance, a possible risk in the case of glucose administered by mouth. During the days set apart for the determination of the tolerance the animals were kept in metabolism cages.

Two months after performing the phrenicosympathetic anastomosis on dogs, the assimilation limit for saccharose lay between 15 and 12.5, which is remarkably high. In Case 7, three or four months after operation it was considerably lower, below 10 in Cases 1 and A. And about three months after a phrenic-vagus anastomosis in Case 10, it was as low as at about the same period after a simple phrenicotomy in Case 12, in both cases between 5 and 2.5. In cats the figures were invariably low. Yet it should not be ignored that excepting Case 5 they were somewhat higher in tests made on animals not operated upon, than in those operated upon. In Cases 8 and 14 the sugar tolerance was between 10 and 5, in other words above 5 before the operation. In Case 11, it was between 5 and 2.5 before operation, the same figure as was found in Case 5 three and a half months after phrenicosympathetic anastomosis, and the remaining three cats (Cases 3, 4 and 6) 3½ to 6 months after operation, likewise with phrenicosympathetic anastomosis, displayed an assimilation limit between 2.5 and 63. Spontaneous glycosuria or albuminuria was found in spite of frequent examination in only one case and temporarily. No 8 glycosuria during a couple of days after operation and never on any other occasion.

As far as dogs are concerned, I had but one opportunity to compare with the sugar tolerance in an animal on which no nerve anastomosis had been performed. This dog (already mentioned in this paper) had an assimilation limit below 5 two months after ligation of one of the superior sympathetic neck ganglia. My last investigations on cats (Cases 8, 11, 14) I planned in the following way. The

¹ Best J. Clin. Chem. 1914, 20, 8.

² Vuchow's Arch. f. path. Anat. 1856, p. 144.

³ Bull. Johns Hopkins Hosp. 1911, 22, 165.

⁴ See Hawk's Physiological Chemistry Philadelphia 1912, p. 327 and Wood's Chemical and Microscopical Diagnosis New York and London 1912, p. 575.

sugar tolerance was tested in each case at about the same time. Then I performed in the thoracic cavity in one of the cats a phrenicosympathetic anastomosis and in another a phrenicovagus anastomosis, not operating on the third animal. Afterward I kept them all in the same cage and under quite equal conditions. They did very well for the first six weeks. Whereupon they were struck by an infection (catarrhal disease of the respiratory tract) and developed for a time a rather bad general condition as well as did all the other animals in this room. The two cats operated upon improved, to a certain extent did the third animal, not operated on, which died after two months before I was able to carry out another assimilation test. Cat B showed the same sugar tolerance 111 days after performing the nerve anastomosis as she did after 175 days.

As for the remaining symptoms indicative of a condition of sympatheticonus, vagotonus, or hyperthyroidism it may be briefly stated that no unquestionable ones were found. Loewi's adrenalin test was negative in the five cases in which it was applied. In the eyes no other symptoms were found than the customary effects (paralysis) on the operated side. I was particularly looking for a possible appearance of the interesting phenomenon which Cannon observed in one of his animals but which Langley could not find, namely, exophthalmos and the respiratory huppus. In spite of numerous investigations, both in broad daylight and in dim light I never could detect any such phenomenon either in dogs or in cats.

Equally unsatisfactory were the macroscopic and microscopic findings in the organs at autopsy. In dogs 1 (anastomosis of the right phrenicosympathetic) and 13 (sympatheticotomy on left side) there was found, in the abdomen, a very peculiar picture of a seemingly chronic inflammatory nature. Numerous firm adhesions and strands of connective tissue were present; the intestines showed occasional local saclike extensions and the mesenteric glands were enlarged, indurated, and pigmented.

I have no information regarding the real nature of these changes. In the rather numerous autopsies I have had occasion to perform on dogs I have observed them in only one additional case, and that in a dog who had already undergone ovariectomy on both sides and three weeks later had been fed daily 2 to 5 gms. thyroid extract for eighteen days. Here glycosuria and a marked deterioration of

the general condition developed. After stopping thyroid feeding the glycosuria disappeared. The animal died a few days later of pneumonia, however. The autopsy showed, among other things, exactly the same changes in the abdominal cavity as described above. The thyroid was normal.¹

In some cases (Nos. 1, 3, 5, 6, 8, 13) I undertook a histological examination of the inner organs after staining either with hamotoxylin-eosin, or in the case of the adrenals, sudan. The only noteworthy observations that resulted were the following. In Cases 1 and 2 the liver was rather vascular, and, in Case 3, the liver was vascular and rich in pigment also. In Case 13 the thick-walledness and the hyaline appearance of the medium sized vessels in the spleen were striking, besides, the pancreas was fairly vascular. No kidney changes were observed. In Case 3 the adrenals, especially the right, were rich in blood and it also showed a cortex rich in pigment. Only in Cases 1 and 8 was the thyroid examined microscopically. It was colloidial and had in Case 5, gland epithelium seemingly in two layers in places without any indication that a papillary hyperplasia was forming.

Eppinger, Falta, Rudinger and others consider the symptoms in conditions of hyperthyroidism as evidences of a state of sympatheticonic stimulation. Biedl and others point out that some of the symptoms evidently belong to the autonomic nervous system and therefore, that the multitude of syndromes in hyperthyroidism can only be explained by the assumption of a polyvalent thyroidal secretion. Halsted expresses doubts as to the definiteness of our knowledge as to which symptoms are really vagotonic.

However, we cannot attempt to decide these differences this moment. Following the investigations of Langley and Cannon, I made attempts to study experimentally several questions involved. My report on the experiments, I need hardly point out, has yielded very little of a positive result. To be sure the animals on which I operated did in a few cases, as did all of those operated

¹ On the histology of the thyroid gland in animals under thyroid feeding and under other specific diet, see J. Langley, Proc. Roy. Soc. Med. Path. Soc. 1914, p. 49 and J. Douglas, J. Path. & Bact. 1915, xix, 347, also MacCallum, J. Am. M. Ass. 1907, xlix, 1, 158.

upon by Cannon develop, "peculiar symptoms," but it was impossible to stamp them decidedly as either sympatheticonic or vagotonic, nor is there any agreement between the various individual cases along the lines of the operation performed. In explanation I merely call attention to the comparatively high sugar tolerance (between 15 and 12.5) in Case 7, and the very low one (1.25 to 0.63) in Case 4, not to mention such peculiarities as diffuse corneal opacity in Case 1, chronic peritoneal and intestinal changes in Cases 1 and 13, etc.

No doubt very extensive series of investigation are required in order to determine with certainty which symptoms in the cases of animals kept in long confinement may, after performing these nerve anastomoses, be referred to states of sympatheticonic or vagotonic conditions or to hyperthyroidism. My set of 17 cases is by no means large enough. Yet as I have not now the opportunity to complete them with new investigations, I consider that the publication of the results may be of some interest.

A few remarks may be added concerning the cause of the absence of any definite symptoms resulting from, for instance, a phrenicosympathetic anastomosis, even as I shall for the present assume, such a one being present for a long time.

Opinions have been divided as to the behavior of the different components of such hybrid nerve, as far as transmission is concerned. It may be that the nerve fibers have no inherent function in themselves but that of conduction as in the cases of the metallic wires of an electric battery. What effects are produced depends entirely on the character of the end organ to which the nerves conduct. But it is also possible that the nerve fibers themselves have some importance in determining the nature of the effect and that they may be capable of changes with respect to this function. Langley interprets two of his experiments along the lines of the hypothesis. In one case, after uniting the severed central end of nervous lingualis (containing vaso dilators) with the peripheral remnant of the sympathetic nerve (conduct-

ing vaso constrictors), and on stimulation of the hybrid nerve, he obtained a contraction of the ear arteries. Similar phenomena were observed in vago-sympathetic anastomosis. Without going into the theoretical aspect of these questions, I should like to simply present a few further observations thus far made.

Rawa¹ joined the central end of the vagus with the peripheral end of the hypoglossus and observed that the former nerve thus acquired a certain degree of motor effect on the muscles of the tongue. Cushing² having a patient with facial paralysis, the result of a bullet wound perforating the mastoid process, sewed up the central end of the accessory nerve after having completely severed it with the peripheral remnant of the main trunk of the facial nerve. Six weeks after the occurrence of the trauma, this operation was performed and the outcome was fairly satisfactory as far as the facial paralysis was concerned. In time the patient acquired the faculty of coordinated simultaneous motions on both sides of the median line of the head, but even nine months later, associated movements persisted in the injured half of face when the shoulder (trapezius) and head (sternomastoid) were vigorously moved.

It is of particular interest to compare with these results the observations of Langley in animals. After uniting the central end of the fifth cervical nerve with the peripheral end of the sympathetic (in two cats) he found, still after 187 days and 112 days respectively, the ordinary symptoms of sympathetic paralysis in the corresponding eye. But the proximal section of the hybrid nerve had not obtained any tonic effect on its distal section. And the motions of the neck and shoulder, the impulses for which normally run through the fifth cervical nerve, caused no movements in the nictitating membrane or pupil. Langley's similar experiments on a third cat, in which, after 197 days, he found that also the diaphragm had no associated movements in the pupil, have been referred to above.

¹ Arch. E. Anat. & Physiol. 235, p. 296.

² J. Nerv. & Ment. Dis., 1903, xxx, 167.

It seems to me that the difference in the results found in Cushing's and Langley's cases correspond very well to the differences in the kinds of nerves that were united in the former cases there was union of such closely related nerves as the accessory and the facial, both motor nerves, the latter's work involved joining such different nerves as those from the cerebrospinal system and those from the sympathetic nervous system. It would be an entirely reasonable conjecture that in my cases both neck and thorax operations such details may have played a part. But it is impossible for the present to judge whether this have been influential too, in any way by the fact that in severing the phrenic nerve centripetal communication and transmission through that nerve were broken.

FIRST SERIES OF CASES. CEREBRAL OPERATIONS.

CASE A. Dog, medium sized, left phrenic nerve sutured to left sympathetic, under observation 111 days. Shortly before death weighed 840 gms. average pulse rate 111.5 counts. sugar tolerance between 10 and 15.

Other symptoms of interest. Weight falling off but some sluggishness, becoming of left pupil and 1 1/2 left left pupil not reaching to light.

Remarks. After operation left pupil and 1 1/2 left were less than before the irritating cream was pulled forward toward the pupil epithelium. From 38 days after operation these symptoms were less pronounced. From about 100 days after the operation there was no difference in the position of the left nistitating nictitating membrane from the position of the right one. 74 days after operation the eyes were carefully examined with a flash light in a dark room, nothing especially revealed. Left pupil was always materially lessened not reaching. Later the same results were found several times. During the last 6 weeks before killing the dog, purulent conjunctivitis was present especially in the left eye. The dog's general condition was good until the last few days before death when he lost during the sugar tolerance tests 4.450 gms. At the autopsy the suture place of the nerve was nicely healed and could not be exactly distinguished. Thyroid was rather large translucent (colloidal). Stomach not very large.

CASE B. Cat, male, left phrenic sutured to left sympathetic, under observation 175 days. Shortly before death the animal weighed 4400 gms. average pulse rate 136-14 counts. sugar tolerance between 2.5 and 1.25.

Other symptoms of interest were: Some hair fallen out on a spot about the size of a penny below left

ear. Eye symptoms about the same as 2 months ago, the size of the pupil (left) though varying from day to day does not seem to be as small as 2 months ago.

Remarks. The usual symptoms of sympathetic paralysis were found in the left eye following the operation. From 12 days after the operation the left pupil was sometimes only a little less than the right. In spite of numerous examinations in dim light respiratory movements never were found in the left eye. Three and one half months after operation the sugar tolerance lay between 2.5 and 1.25 the pulse rate was 137 (130 counts) the weight 4430 gms. Left pupil and 1 1/2 left were small, left nictitating membrane pulled forward (but no evident epithelium). Thus far no falling out of hair. The general condition good as I remained so even at the time when the cat was killed. Autopsy showed no gross internal organs without remarks, the nerve suture place smooth and practically not to be detected.

CASE C. Cat, weight 2640 gms. left phrenic sutured to left sympathetic, under observation 20 days. Shortly before death the animal weighed 1600 gms. average pulse rate 135 (14 counts).

Other symptoms of interest. During the last week before death the general condition went down rapidly.

Thus no sugar tolerance test could be done.

Remarks. Here 2 to 3 cm. of the left sympathetic were excised below the superior ganglion whereupon the phrenic was sutured to the ganglion itself. Left eye showed the same as paralysis yet epithelium was not evident and the nictitating membrane was just slightly pulled forward. During the last day preceding death there was purulent conjunctivitis in both eyes. Bladder urine at the autopsy was free from sugar. Cause of death postoperative infection. The nerve suture had slipped. Thyroid normal.

SECOND SERIES OF CASES. THORACIC OPERATIONS.

CASE 1. Dog, eight phrenic sutured to right sympathetic, under observation 85 days. Shortly before death the animal weighed 1070 gms. average pulse rate 114 counts. sugar tolerance below 10.

Other symptoms of interest: Loss of weight, falling out of hair, tired or weakness, diffuse corneal opacity during the last 2 months.

Remarks. Urine free from sugar 2.7.8.9.60.61. 84 days after the operation (as well as the day of the operation). The dog was quite well until 2 days before death which was caused by pneumonia. Autopsy showed the place of the nerve suture which was nicely healed with callous like swelling. Otherwise nothing worthy of note except that the intestines showed occasional local scars like extensions and the mesenteric glands were enlarged indurated and pigmented. Numerous firm adhesions and strands of connective tissue were present.

Case 2 Dog, weight 6,860 gms, right phrenicus sutured to right sympathetic, under observation 105 days. Shortly before death the animal weighed 3,435 gms.

*Other symptoms of interest*¹ During the last month of life death very sensitive, during the last week sluggish too. Loewi's test negative.

Remarks Before operation the pupils were measured and equal. This fact was noted in every autopsies, though not always mentioned. Sugar free before operation, 35 days and 45 days after operation. Cause of death, pneumonia. The point of nerve suture healed with callous like swelling of internal organs without findings.

Case 3 Very large dog, left phrenicus sutured to left sympathetic, under observation 20 days.

Remarks Urine free from sugar at the time of the operation and 9 days after. Dog seemed to be quite well until he was found dead one morning. Autopsy pneumonia. No signs of postoperative infection. The point of nerve suture very healed thickened. Stomach and intestines small. Left kidney a little larger than right.

Case 4 Cat, left phrenicus sutured to left sympathetic under observation 107 days. Shortly before death the animal weighed 3,435 gms, average pulse rate 133 (5 counts), sugar tolerance between 1.25 and 0.63.

Remarks The general condition of the animal excellent all the time. No falling out of hair. Urine equal reacting to light. Urine free from sugar and albumin 2 months after operation and at time of death. The cat was killed under ether. Autopsy very much adipose (increase in weight before death by weighing at the beginning and at the end of the last week). Internal organs without findings. The point of nerve suture without swelling. Thyroid rather large.

Case 5 Young cat, left phrenicus sutured to left sympathetic under observation 105 days. Shortly before death the animal weighed 3,375 gms, average pulse rate 126, sugar tolerance between 1.25 and 0.63.

*Other symptoms of interest*¹ Loewi's test negative. *Remarks* All the time in excellent condition. No falling out of hair. Pupils equal wide, reacting to light (3 days after operation). Urine sugar free (3 months after operation). Cat killed under ether. Autopsy adiposity (and increase of weight) stated in Case 4. The point of the nerve suture surrounded by adhesions between the pleural sheaths. Much large. Thyroid very small non transparent. Microscopically. The follicles of the spleen very evident (young animal).

Case 6 Cat left phrenicus sutured to left sympathetic under observation 100 days. Shortly before death the animal weighed 4,700 gms, average pulse rate 133 (4 counts), sugar tolerance between 1.25 and 0.63.

*Other symptoms of interest*¹ Loewi's test negative. *Remarks* Condition excellent all the time. No falling out of hair. Urine sugar free (1½ months

after operation). Some decrease in weight was noted during the last week before death. Autopsy very much adipose. Adrenals small. Left thyroid lobe large, right lobe less and not quite as much transparent. The point of nerve suture fine, not swollen. During the narcosis (in which the animal was killed) the left phrenic nerve was stimulated with an electrical current, but without any visible effect in the opened abdomen.

Case 7 Dog, female, left phrenicus sutured to left sympathetic under observation 57 days. Shortly before death the animal weighed 9,500 gms, average pulse rate 133 (5 counts), sugar tolerance between 1.5 and 1.25.

*Other symptoms of interest*¹ Some signs of itching, falling out of hair especially so during past two weeks.

Remarks All the time in excellent condition. Some loss of weight was noted during the last week preceding death. Pupils equal reacting. Urine sugar free (2 weeks and five weeks after operation). Dog killed in narcosis. Autopsy the point of the nerve suture not to be detected. Stomach very large. Thyroid very large. Otherwise nothing to remark.

Case 8 Cat left phrenicus sutured to left sympathetic, under observation 70 days. Shortly before death the animal weighed 2,850 gms, average pulse rate 142 (7 counts), sugar tolerance between 5 and 2.5.

*Other symptoms of interest*¹ Backward to the left an almost bald spot about the size of a fifty cent piece.

*Remarks*¹ The days following the operation showed a pulse rate of 135 (5 counts). Still a dry after operation the urine showed sugar reaction. Two weeks before the animal was killed all the animals kept in one laboratory room (including Case 8) acquired a severe catarrhal disease of the respiratory tract and developed a bad general condition. Case 8 improved some after a little more than a week. Autopsy adipose (especially in omentum and mesentery). The point of nerve suture nicely healed with callous like swelling. Internal organs without remark.

Case 9 Dog left phrenicus sutured to left vagus under observation 27 days.

*Remarks*¹ Good condition during the past few weeks. Then loss in weight. Dog rather emaciated at the time of death. No cause of death found (dog fight?). No signs of infection. Nerve suture placed nicely healed. The spleen showed an organized infarct. Stomach small.

Case 10 Dog left phrenicus sutured to right and left vagus under observation 87 days. Shortly before death the dog weighed 4,670 gms, average pulse rate 108, sugar tolerance between 5 and 2.5.

*Other symptoms of interest*¹ Much falling out of hair. Signs of itching. Thickened skin. Some sluggishness during last two weeks. Loewi's test negative.

Remarks Sugar free urine 1½ months after operation. During the narcosis (in which the

animal was killed) electric stimulation of the left phrenic was made with no result in the abdomen. Internal organs without findings. Fine nerve healing.

CASE 11 Cat, female, weight 2,480 gms., left phrenic sutured to right and left vagus, under observation 64 days. Shortly before death the animal weighed 2,130 gms., average pulse rate 149 (3 counts), sugar tolerance between 5 and 25.

*Other symptoms of interest*¹ Was delivered of 5 living kittens four days previous to death.

Remarks During the days following operation the pulse rate was 141 (3 counts), sugar free urine before death as well as 3 days after. Two weeks before killing the animal the same infection developed as in Case 8. Autopsy nothing especially to remark. Nerve suture place fine, not swollen.

CASE 12 Dog, left phrenicotomy, under observations 99 days. Shortly before death weighed 11,690 gms., average pulse rate 114 (6 counts), sugar tolerance between 5 and 25.

*Other symptoms of interest*¹ Talling out of hair. Signs of itching very pronounced. Loewi's test negative.

Remarks General condition good all the time. Sugar free urine before operation and 1½ months after. At the time of killing the dog, he was very thin, during the past 3 weeks preceding this, 3½ kilo

loss in weight had been noted. At the operation, left phrenic and both vagi were cut; at the autopsy the vagi were quite healed together, only phrenic remained severed. Thyroid rather small. Otherwise nothing to note.

CASE 13 Dog, left phrenicotomy, under observations 73 days.

*Symptoms of interest*¹ Talling out of hair, loss in weight.

Remarks Pupils medium and equal before operation. Urine sugar free one day and also 1 month after operation and at autopsy. Good general condition. Cause of death pleuropneumonia. At the operation the phrenic, the sympathetic and both vagi had been cut, at the autopsy all these nerves were healed except the sympathetic. Changes in the intestine and peritoneum quite similar to those found in Case 1, were present. Sugar tolerance test was not done, as the dog refused to eat sugar.

CASE 14 Cat, weight 3,030 gms., under observation 56 days.

Remarks Sugar tolerance test, pulse count, etc., were made in this cat at the same time as in cases 8 and 11. The severe infection mentioned above which later developed interfered with the original intention to test out changes that in time might have occurred. Case 14 died before any further test had been carried out.

¹At time of death.

TRACHELOPLASTIC METHODS AND RESULTS¹

A CLINICAL STUDY BASED UPON THE PHYSIOLOGY OF THE MFSOMETRIUM

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THE first plastic amputation of the cervix uteri, utilizing a cuff of vaginal mucosa as a stump covering, was practiced by Marion Sims in 1861. One year later, T. A. Emmet performed his first successful trachelorrhaphy; the technique and results of which, however, were not published until 1874. In discussing Emmet's operation Sims declared: "We can't modify it, we can't change it, for it is perfect — perfect in its method and perfect in its results."

Emanating from so prominent a source and indorsed by such authority, these operations, which embody the origin and principles of all subsequent tracheloplastic methods, found enthusiastic adoption in America and to a large extent in England, while, at the same time their introduction among Continental surgeons instigated an interminable maze of controversy and modifications.

Today, after a tenure of over fifty years, we are beginning to realize that the prevailing convictions as to the uniformity in the beneficial results of these established operations demand a most radical revision. This is significantly revealed in a recent analysis by Dr. V. N. Leonard of the Johns Hopkins Hospital, who tabulated the immediate and ultimate effects of the classic cervix amputation as performed in Howard Kelly's clinic during the past twenty years. One hundred and twenty-eight complete post-operative histories from among four hundred recorded cases forced Leonard to conclusions which, to quote his own conservative phrasing, "were quite unexpected and in many ways disappointing" for —

Nearly 5 per cent of the patients presented serious post-operative hemorrhage, occasionally after established convalescence.

Ten per cent of the cases suffered from decided augmentation of a preexisting menorrhagia or dysmenorrhoea.

Four fifths of the women in whom pregnancy

might reasonably have been anticipated to follow the operation remained sterile.

On the other hand, 50 per cent of the pregnancies occurring after cervix amputation terminated prematurely, while among the few who progressed to full term, even a larger proportion experienced difficult and prolonged labor.

The operation in all of the cases presented, consisted of the classic circular amputation, removing about three centimeters of the cervix above the external os.

Actuated by these "unexpected and disappointing results," Leonard next tabulated the post-operative effects of *trachelorrhaphy* for comparative analysis with those of *cervix amputation*, concluding as follows:

The presence of a marked endocervicitis should be considered as contra-indicating simple trachelorrhaphy, for although trachelorrhaphy may render a mild endocervicitis more amenable to treatment, it cannot be considered like amputation of the cervix — a curative measure for this condition.

Fertility is much more likely to follow trachelorrhaphy than amputation of the cervix.

After amputation of the cervix, the incidence of abortion and premature delivery is greatly increased, while trachelorrhaphy has no effect upon the course of subsequent pregnancy.

Labor after cervix amputation is usually difficult, while after trachelorrhaphy it is almost always normal; hence amputation of the cervix is to be avoided in the child-bearing period, trachelorrhaphy being the operation of choice in *properly selected cases*.

I have quoted Leonard's conclusions at some length because they offer, from a representative source, substantiation of my contentions and incentive for innovation into the prevailing principles and practice of established tracheloplastic methods. Accepting these introductory data as a correct exposition of facts, the problem presented resolves itself into two fundamental questions; namely,

What criteria should determine the selection of simple trachelorrhaphy in a given case, and, secondly, how shall we perform an indicated cervix amputation without incurring

¹ Presented before the Medical Society of the County of New York, October 25, 1915.

the post-operative hæmorrhage, the disturbances in menstrual, reproductive, and parturient functions enumerated above?

If we recall that it is not the cervical laceration as such, but its consequences, which we attempt to prevent or cure by operation, the enumerated post operative derangements make it conspicuously evident that the prevalent methods of cervix amputation, while surgically successful, not only fail to restore normal functions in a large proportion of cases, but are capable of inciting the identical disturbances for the relief of which the operation was instituted. That it is not the tear in the cervix, but the induced complications which bring the patient to the operating table, is amply demonstrated by the countless women who bear cleft cervixes presenting ununited cicatrized edges, unproductive of any symptoms whatsoever, and it follows as a self-evident deduction that the limitations of trachelorrhaphy like the indications for cervix amputations must be governed by the nature and degree of existing concomitants, not by the extent of the cervical injury. A single tear may initiate the most serious train of complications in one patient, while a more extensive multiple injury may prove perfectly innocuous in another.

The dominating fundamental factor that establishes the morbidity of a cervical lesion is the incidence of infection. Clinically, the course of such infection assumes one of two types according to its virulence and the resistance of the patient. In the first instance it reveals itself frankly as a form of acute puerperal sepsis with gradual subsidence of its systemic manifestations or, what is more common, it pursues a more or less insidious latent course from the beginning. The first form usually merges into the second, so that ultimately both eventuate in varying degrees of the same symptom complex.

The objective and subjective features presented in this chronic stage of the condition are amply and graphically depicted in every textbook, but the nature and significance of the intermediate pathologic phases in the morbid chain that link cause and effects are obscured by a haze of standardized misconceptions and fallacious dog-

ma. Thus the theory of reflex neuroses from alleged "pinching of the cervical nerves by scar-tissue in the angles of laceration" is almost, but not quite, obsolete; yet equally absurd is the accepted statement that the relative sterility of women with lacerated cervixes is due to a cicatricial stenosis of the cervical canal, for it is obvious that an os which affords egress to billions of blood-cells during every menstruation, will certainly give ingress to an active spermatozoid, the thickest part of which measures less than half the diameter of a single red blood-corpuscle.

Similarly, the familiar "chronic corporeal endometritis," generally accepted as the pathologic fundament of cervical lesions productive of its complications, is a misnomer and a myth found only in textbook classification, rarely in the uterus.

Kundradt first, in 1873, and more recently Hirschman and Adler, have conclusively proved that nearly all of the histologic features generally depicted as "endometritis" present only the normal endometrial transitions of the menstrual cycle. Even that infrequent form clinically labeled "hyper-trophic endometritis" more correctly termed glandular hyperplasia, is never inflammatory in character, but a functional adenomatous overgrowth, analogous to that presented by the thyroid in Graves' disease.

Furthermore realizing that the cervix as such is practically devoid of function, that physiologically it represents nothing more than a passive communicating duct between the vagina and the uterine cavity proper, that its lining membrane simply secretes mucus, that it does not participate in the metamorphosis exhibited by the corporeal endometrium during menstruation or pregnancy the question naturally arises. How are the disturbances in menstruation, conception pregnancy and parturition induced by cervical disease? The answer to this question embodies not only the solution of our present problem but of many others of equal importance in gynecological pathology.

Menstruation, conception, pregnancy, and labor are intrinsically corporeal functions, and the elucidation of disturbances in these functions must be sought beyond the cervix.

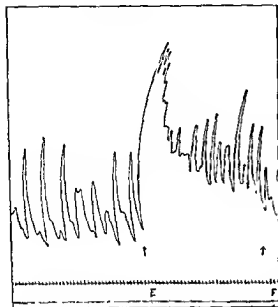


Fig 1 Human uterus non pregnant longitudinal fibers Four hours after operation Strip $3 \times 0.5 \times 0.5$ cm Load 1 gm Temperature 30°C At E, epinephrine to make 1:2000000 (From Lieb, *American Journal of Obstetrics*, vol lxxi, 2)

The functional integrity of any organ depends essentially upon the maintenance of a uniformly normal circulatory equilibrium. This is conspicuously true of the uterus, the specific activity of which, in menstruation and pregnancy, demands a range of local circulatory oscillation that obviously implies the existence of some regulating mechanism.

The uterus, like the heart, is practically a hollow muscle, and like the heart it automatically controls its own blood supply. From time immemorial we have been familiar with the characteristic contractile phenomena manifested by this organ during pregnancy and labor, nevertheless this identical contractile function as the intrinsic and essential regulator of its normal circulatory balance, remains unrecognized.

Rhythmical contractions of the non pregnant uterus were first graphically recorded by Hensenius twenty-six years ago. It is now more than five years since last I directed attention to the clinical bearings of this factor in the following words:

"Complying with established physiological

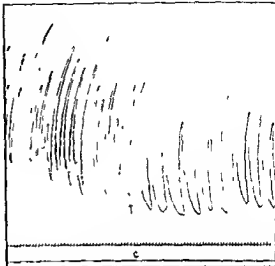


Fig 2 Human uterus, non pregnant, longitudinal fibers Three hours after operation Strip $3 \times 0.5 \times 0.5$ cm Load 1 gm Temperature 30°C At C, pilular to make 1:1000 (From Lieb, *American Journal of Obstetrics*, vol lxxi, 2)

laws, a normal uterus contracts at regular intervals not only during pregnancy, but throughout its entire functional existence, such contractions being essential to its structural and circulatory integrity. An immobile muscle, whether in the uterus or elsewhere, degenerates, furthermore, the uterine veins being devoid of valves, leave no provision other than muscular contraction to prevent circulatory stasis and its consequences."

The recognition and significance of these normal intermittent contractions in the non-pregnant uterus, have not as yet permeated far beyond the confines of the research laboratory, but there we command graphic tracings revealing, in uniform cycles, rhythmic successions of systole, diastole, and quiescent interval, all augmented during pregnancy and menstruation.

Two familiar clinical manifestations will serve as a practical demonstration to depict the extreme phases of this muscular vitality in the non gravid uterus. The time-honored practice of applying silver nitrate solutions on a cotton-wrapped probe to the endometrium, induces, in some patients, a most distressing tetanic response of the whole uterine musculature, which firmly clutches the ap-



Fig 3 Injection specimen normal multiparous uterus A, arteries, V, veins, a, b, c, lymphatics, d, transition of lymph capillaries into lymph spaces, e, lymph spaces, f muscle-bundle (from Leopold)

plicator, causes violent colicky pains, and mild but unmistakable symptoms of general shock. no hibernating muscle can manifest such tonicity. On the other hand, an equally distracting moment is experienced when, during a curettage, the operator suddenly finds himself "beyond his depth," the curette losing contact by a paralytic dilatation of the uterine cavity, simulating traumatic perforation of the uterine wall. only a virile muscle exhibits such absolute paralytic

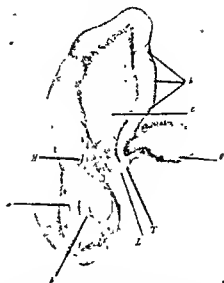


Fig 4 Injection specimen uterus of sheep H, left horn, T, tube, O, ovary, B, broad ligament, a sub-serous lymphatics, b, collecting lymph tube, c, transit into broad ligament channels (from Leopold)

flaccidity. Between these two extremes we will find every grade of perverted muscular irritability with its objective and subjective concomitants.

It is such a perversion of muscular function, impairing the intensity and rhythm of the uterine contracting cycle, which we must learn to recognize as the morbid link between cervical lesions and their clinical manifestations.

This contention finds its substantiation in the morphology of the myometrium. The key to the architectural scheme of the uterine musculature is revealed in its formative, not in its matured, state, and to gain a clear conception of its mechanism it is necessary to discard the accepted subdivision of this single muscle into several layers. Such a subdivision is purely arbitrary, there are no distinct layers, but a single muscle presenting different angles in the course of its component bundles. Briefly stated, these bundles are arranged in a succession of fanshaped muscle-sprays that wind spirally downward from each fallopian angle throughout the whole uterus to the external os. Schematically, the intersection of these spirals forms a net-

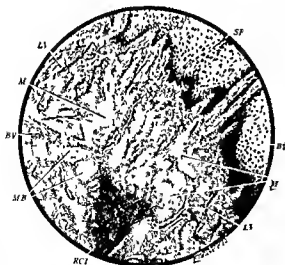


Fig 5 A section through the cervix showing sub-epithelial inflammatory foci. Hyperplastic lymph vessels with streaks of round cell infiltration and small inflammatory foci in the cervical musculature. SF, Squamous epithelium, BV, blood vessels, M, muscle, LV, lymph vessel, MB, muscle bundle, RCI round-cell infiltration



Fig 6 Infiltrated lymph vessels in the muscular stroma (perimyrium) of the cervix



Fig 7 Dense round cell infiltrations in the sub-epithelial layers and muscular stroma of the cervix

work of inverted figures of eight, the large upper loops constituting the fundal segment while the lower circular loops enter into the formation of the cervix

Every muscle contracts toward its fixed point and for the uterine muscle such relative fixed points are furnished through its fascicular prolongations in the round and broad ligaments at the pelvic brim

To appreciate the influence of cervical laceration upon the mechanism of uterine contraction it is essential to dispel the accepted myth of a distinct cervical sphincter. Such a sphincter implies the existence of a concentrically contracting muscular ring. The muscular arrangement of the cervix precludes any concentric closure of the os, which dilates with every uterine contraction because the muscle spirals do not at any point completely encircle the cervix, but are disposed as a progressive lamellated, interrupted succession of short oblique circle segments which, contracting spirally upward toward their fundal fixed points, necessarily shorten every diameter of the uterus and by uncoiling in the cervix, open the os in the manner of an iris diaphragm in a microscope, cervical dilatation thus becomes an *active contractile phenomenon* instead of a *passive relaxation* as heretofore taught

This perfect adaptation of muscular arrangement to the physical and physiological requirements of uterine function is demonstrably exemplified during labor when the mechanism is exercised on an augmented scale

We have already emphasized that it is not the laceration as such, but the incidence of its infection that determines the morbidity of a cervical lesion, and it remains to elucidate with special stress that pathological phase of the infectious process which clinically, at least, presents a *terra incognita* to the gynecologists

In the uterus as elsewhere, every infection incites the greatest reaction in its lymphatic elements. The enormous uterine resorptive capacity displayed in its gravid and puerperal state is exceeded only by that of the intestines. It is more than forty years since Leopold clearly demonstrated the normal uterine lymphatic circulation, nevertheless, barring its disseminating rôle in cancer, the domination of this element in general gynecological pathology has been practically ignored

Quoting briefly from Leopold's description, which stands unchallenged to this day, the uterine lymph current may be traced from its lacunar origin under the endometrium and cervical mucosa, through minute funnel-

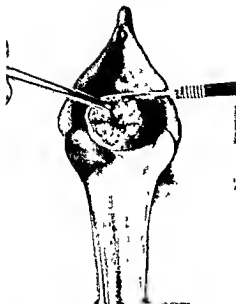


Fig. 8 Outlining the circular flap at the demarcating border between the healthy vaginal margin and the diseased mucosa



Fig. 9 Mobilization of flap completely around the cervix up to the level of the internal os

shaped ostia directly to the myometrium. Here it expands into an extensive capillary net, which, utilizing the perimysium as a scaffold, *enmeshes every fascicle and bundle of the uterine musculature to its subperitoneal surface*, whence it drains into two main collecting tubes that course parallel to the utero-ovarian blood-vessels in the base and top of the broad ligament.

This normal envelopment of the perimysial sheaths throughout the uterine musculature by a lymphatic lattice work, makes it clear how an infectious process of the cervix, inducing an ascending intramuscular lymphangitis, may splint and immobilize the elementary muscle bundles by plastic infiltration of their sheaths. Ramifying the entire myometrium along these sheaths, this chronic lymphangitis may create disseminated minute myometrial abscesses, as shown in Figures 5, 6, and 7, then converging to the lines of the main lymphatic channels, its course is evidenced by paracervical exudates and velamentous bands or meshes which kink and agglutinate the adnexa, inhibit tubal peristalsis, create di-

verticuli that establish ectopic possibilities, or, occluding the tubal ostia, insure sterility.¹

The peri adnexitis thus produced, thickens and agglutinates the ovarian tunica albuginea, prevents the normal rupture of graafian follicles with ultimate development of retention cysts and functional amenorrhœa. Here is the incubation of chronic pelvic abscess, pyosalpinx, sactosalpinx, ovarian sclerosis, and so called "uterine fibrosis."

Thus intramuscular lymphangitis and its resulting impairment of the normal myometrial contractions furnish the pathologic factors that link cervical lesions and their clinical manifestations.

To deduce all of the functional disturbances resulting from these two pathological factors is to reconstruct the whole symptomatology of cervical lesions.

When in the case of the heart, the myocardium becomes impaired cardiac arrhythmia ensues with resulting general circulatory stasis, frequently productive of myocardial

¹ I gratefully acknowledge my indebtedness to Dr. Emil Schwarz, Assistant Lying-in to the Woman's Hospital for the illustrations, Figs. 5, 6 and 7.

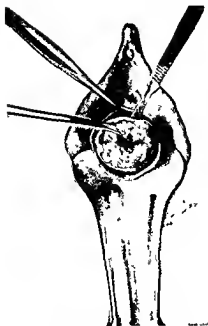


Fig 10 Enucleation of the entire cervical mucosa out of its muscular bed



Fig 11 Raw funnel of cervical muscularis and excised cone of mucosa

menorrhagia. Similarly, when the myometrium is impaired, a uterine arrhythmia ensues, with resulting local circulatory stasis productive of myometrial menorrhagia. And, again, under the influence of vagus stimulation, cardiac contractions decrease in frequency but increase in force, the identical phenomenon occurs normally in the uterus during every menstrual period.

Dysmenorrhœa means painful menstrual contractions. The myometrial sensory nerve-filaments penetrate the muscle sheaths, and consequently the normally augmented menstrual compression of infiltrated perimyrial areas causes dysmenorrhœa. On the same pathological basis, the associated nutritional and functional derangements of the endometrium disturb or inhibit its specific decidual potentialities, with consequent sterility or premature termination of existing gravidity.

It is an axiomatic surgical principle in the control of any progressive ascending lymphangitis to direct our therapeutic aim at the primary infectious focus, and it follows as an obvious corollary that the indications for,

and limitations of, trachelorrhaphy or cervix amputation respectively, must be governed by their relative efficacy in the elimination of the infectious cervical focus and the restoration of normal uterine functions.

With the cervical lesion as an established portal of infection, simple trachelorrhaphy should find its cardinal and practically its only sphere early in the puerperium, when "immediate" or "intermediate" operation represents an effort of highest prophylactic potency.

Unfortunately, the enervating exigencies of the lying-in chamber all too frequently incline the accoucheur to close his eyes rather than the rent in the cervix unless copious hemorrhage from a ruptured circular artery imperatively dispels all further disinclination to supplemental exertions.

The early operation purposely or unavoidably omitted and chronic infection ensuing, Emmet's classic trachelorrhaphy as a curative measure presents itself for consideration.

The indications for and limitations of a given operative procedure must be based upon a clear conception of its aim and scope.



Fig. 12. Transverse traction suture for the anterior flap segment *in situ*.

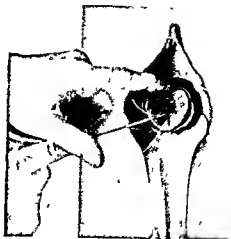


Fig. 13. Introduction of right free suture end into the cervical cavity on a double curved Penzance needle, to a point above the internal os.

Emmet's operation was based upon the conception that the local and general manifestations in torn cervixes resulted solely from gaping flaps and that a cure of the condition demanded nothing more than a plastic closure of the gap. The dominating features of this operation consist of a surgical reproduction of the original tear and its sutural reunion. This at once limits the curative scope of the procedure to cases in which the infection has not extended beyond the borders of the original tear—a rare condition for we know today that the functional disturbances following cervical lesions which demand surgical intervention, signalize the infectious invasion of areas beyond the limits of the primary injury and that the conservation of these invaded areas within the cervix perpetuates the morbid process thus rendering Emmet's trachelorrhaphy practically futile in many cases, notwithstanding an immediate plastic success.

If this is true of single tears, it applies with proportionate force to multiple tears, but whether we accept or reject the foregoing considerations as valid factors in limiting the

scope of secondary trachelorrhaphy as a curative measure, a more sinister menace obtrudes itself into this question today; namely, the enhanced cancerous potentialities in the chronically inflamed cervical areas beyond the range of the Emmet operation.

A recent publication by Ewing, on precancerous diseases, affirms that "chronic catarrhal endocervicitis precedes cancer in the great majority of cases," and the cervical erosion is the most definitely established lesion known to initiate cervical carcinoma. Polese demonstrated this in 34 out of 48 cases. Beckman carefully observed the development of carcinoma in an erosion which he treated for five years.

Early stages of carcinoma from such lesions are described by Waldayer, Ruge and Veit, by Cullen, Schauenstein, Sitzenfrey, and others. Ewing studied three instances of precancerous polyp in eroded cervixes showing metaplastic overgrowth and beginning invasion of the stroma by adenocarcinoma.

Aside from these clinical considerations, many gynecologists have for a long time discarded trachelorrhaphy in the majority of their cases on purely technical grounds. Thus Noble declares that "in cervical lacerations of long standing with marked hypertrophy and nabothian cystic degeneration, amputation is to be preferred, as the con-

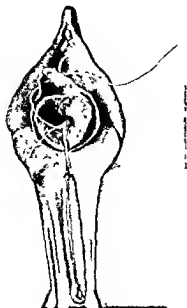


Fig. 14. Needle emerging on the anterior vaginal fornix at base of flap.

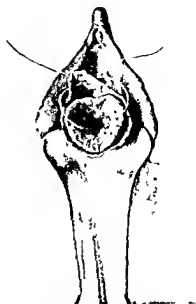


Fig. 15. Left suture end running parallel to and emerging one quarter inch from the right.

ditions left by trachelorrhaphy are far from satisfactory and furthermore, that all cer-vices deficient in bulk from underdevelopment, irregular multiple tears, or previous sloughing, present insufficient tissue for normal reconstruction by trachelorrhaphy."

The foregoing arraignment of this procedure, on physiological, pathological, clinical, and technical grounds, forces the conviction that late trachelorrhaphy, whenever indicated, must prove inefficacious as a curative measure and when apparently curative was probably superfluous.

In thus restricting the applicability of trachelorrhaphy to the puerperium, we necessarily augment the range of cervix amputation as the reparative method of choice for all chronic cervical lesions, and it now remains to elucidate and obviate as far as possible those derangements noted after this operation.

In the light of the normal and pathological fundamentals at hand both cause and prevention of these post operative disturbances are revealed as inherent in the technique of the prevailing methods of cervix amputation.

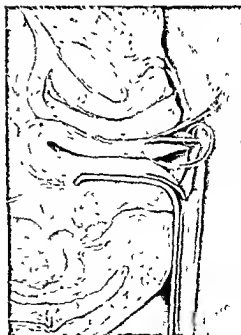


Fig. 16. Schematic sagittal view of anterior suture course.

flap segment runs parallel to the above, but in a posterior direction, its free ends emerging on the surface of the posterior vaginal fornix. Now by tightening each individual set of suture ends, we draw the flap segments into the cervix, line its whole cavity with vaginal mucosa, the edge of which is thus approximated to the circumference of the internal os, where it is retained in apposition as long as desired. In most cases no further suturing is necessary or desirable, but should either lateral edge gape, an additional chromic stitch may be introduced. The sutures are left long to facilitate their removal.

For greater ease and control in directing the suture through the cervical tissues, a double curved Peaseley needle should be substituted for the round needle after engaging the tips of the flap in the first stitch.

A narrow strip of iodoform gauze, introduced with the object of maintaining a flat, uniform coaptation of all raw surfaces, finishes the operation. This gauze is removed after the fourth day, when the patient is permitted to leave the bed and walk about. The silk worm-gut is removed after two weeks when the loops are found loose and accessible.

The specific features of the operative method thus outlined effect the complete elimination of the infectious focus by extirpation of the diseased cervical mucosa, preserve the normal arrangement, contour, and functions of the cervical musculature,

obviate the mechanical difficulty; and secure the permanency of accurate sutural coaptation of flap to stump.

I do not claim an ideal restitution to the normal in all cases — so perfectly a balanced mechanism as the uterus, when once deranged, cannot be perfectly restored by surgery — but I may contend that the procedure here advocated obviates in the greatest number of cases the detailed shortcomings in the prevailing tracheloplastic methods and results.

REFERENCES

- SMITH, MARION. Amputation of Cervix. *Tr Med Soc*, N Y, 1861.
 EMMET, T. A. *Am J Obst*, N Y, 1874.
 LEONARD, V. H. *Surg, Gynec & Obst*, 1913, xvi, 390, 1914, xviii, 35.
 KUNDRAT, II., and ENGELMAN, G. J. *Med Jahrb*, 1873, p 135.
 HITSCHMANN, F., and ADLER, L. *Monatschr f Geburtsh. u Gynak*, 1908, xxvii, 1.
 HENRICIUS. *Finska lak-sällsk handl*, Helsingfors, 1889, xxxi, 349, *Zentralbl f Gynak.*, 1889, xiii, 676.
 STURMDOFF, A. *Metrorrhagia and uterine fibrosis*. *Am J Obst*, N Y, 1910, lxi, No 6.
 LEOPOLD, G. *Die Lymphgefäisse des normalen nicht schwangeren Uterus*. *Arch f Gynak*, 1874, vi.
 EWING, J. *Precancerous diseases and precancerous lesions*. *Med Record*, lxxxvi, No 23.
 POLESE. *Zentralbl f Gynak*, 1906, p 184.
 BECKMAN. *Ztschr f Geburtsh u Gynak*, xlv.
 WALDEYER. *Arch f path Anat*, etc, Berl, lv.
 ROGGE and VEIT. *Ztschr f Geburtsh u Gynak*, 1887, p 261.
 CULLY. *Cancer of Uterus*, p 282.
 SCHRAGENSTEIN. *Arch f Gynak*, lxxxv.
 SITZENFREY. *Ztschr f Geburtsh u Gynak*, lix.
 NOBLE, KELLY, and NOBLE. *Gynecological Abdominal Surgery*, 1903.

DEPARTMENT OF TECHNIQUE

OBSERVATIONS ON UTERINE DISPLACEMENTS

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A WORKING BASIS

THE ligaments of the uterus are its primary supports, while the pelvic diaphragm is the secondary support and prevents undue stretching of the ligaments under the influence of intra-abdominal pressure.

The cardinal ligaments are the main element holding the uterus at a more or less definite level in the pelvis. They are easily felt in the living subject, when the abdomen is opened, as firm bands passing out on each side from the lateral wall of the uterus, the upper free margin commencing well above the level of the internal os, and sloping downward and outward. On the cadaver, after freely opening up the uterovesical pouch, the finger may readily be hooked behind them, stripping off the posterior layer of the broad ligament, and demonstrating them as strong musculofibrous bands extending outward toward the wall of the pelvis. In uterine prolapse the overstretched ligaments may be curtailed by bringing forward a loop of each on to the anterior surface of the uterus and stitching it there (looping the cardinal ligaments). The cardinal ligaments have strong attachments to the vagina and to the posterolateral wall of the bladder.

The round ligaments hold the uterus anteverted on to the empty bladder. On account of their elasticity they permit a certain range of movement of the uterus, which is necessitated by the varying fullness of the bladder. These ligaments consist of two distinct parts: an inner thicker muscular part, about an inch long, which is an extension outward of the uterine muscle, and the remaining outer part, which is rather white in color, and more truly ligamentous. The outer end of the outer part is mainly lost in the mons veneris and labium majus, although bands may be given off near the internal ring to be inserted into the anterior iliac spine and other parts, as with the gubernaculum testis.

The uterosacral ligaments are attached to the second or third sacral vertebra and to the posterior wall of the uterus, a distinct commissure

extending between the uterine ends of the ligaments. The finger tip may readily hook up the commissure from below, a point to be remembered in locating the ligaments when they are not well defined. These ligaments are in a line with the anterior vaginal wall, and therefore with the vesicovaginal fascia of Webster (uteropubic ligaments of Schaffer and others). Clearly the uterosacral ligaments in contracting must act as tensors of the vesicovaginal fascia and of the anterior vaginal wall, which structures lie behind and below the bladder. To this extent the uterosacral ligaments must play a part in supporting the bladder. As far as the uterus is concerned, this contraction of the uterosacrales naturally tends to hold up the organ by suspending it from the sacrum when the patient is in the erect position. Further, since they indirectly support the bladder, they must also indirectly help to support the corpus uteri.

In dealing surgically with uterine displacements any defects in the primary supports of the uterus, i.e., the ligaments, should be remedied, while the secondary support, the pelvic diaphragm, should be repaired if injured.

RETROVERSION

In retroversion both intra-abdominal and extra-abdominal operations to curtail the overstretched round ligaments give excellent results, although it is not easy to defend them on purely scientific grounds. Of the intra-abdominal methods that which carries a loop of the round ligament extraperitoneally through the rectus aponeurosis and fixes it there, is probably one of the best. Alexander's operation has certainly nothing like the vogue it had a decade ago, the tendency nowadays being apparently to attack the ligaments through the abdomen.

My own operation of "restoration of the round ligaments" is, I believe, the most free of objection from a scientific standpoint. The anterior layer of the broad ligament is split parallel to the round ligament, the opening being

closed by a purse-string. The uterus is thereby drawn into anteversion, and brings about a restoration of the round ligaments by physiological rest. At the same time, in very obese women the peritoneum (broad ligament) is apt to be very thin and friable, and in such cases I either loop the round ligaments extraperitoneally on to the rectus aponeurosis, or carry out a simple hysteropexy, as originated by Lawson Tait and elaborated by Howard Kelly. This latter operation is very rapidly performed and therefore is the operation of expediency when the abdomen has been opened and urgency then becomes of the highest importance. At the same time, it is scientifically objectionable, and is really, after all, only a surgical makeshift, while bad after-results, such as intestinal obstruction and abortion, have been reported from time to time. Hence, its place lies in cases where speed is the essence of the contract.

PROLAPSE

In slighter cases of prolapsus uteri an operation for retroversion may be carried out, the uterosacral ligaments curtailed, and at least six weeks recumbency insisted on. The result of this treatment is that the cardinal ligaments get physiological rest, and tend to recontract. I have found this treatment very satisfactory, several cases followed up having stood the strain of parturition without relapse.

In more marked prolapse I loop the cardinal ligaments, and remedy retroversion, after curettage and excision of wedges from the cervix it indicated. While the abdomen is open the uterosacral ligaments may or may not be curtailed. The final step is repair of the pelvic diaphragm if injured. This is preferably carried out as a distinct second operation about three weeks after the primary procedures.

In very pronounced procidentia of long standing, where the uterus, for practical purposes, has become an extra abdominal organ, vaginal hysterectomy may become the operation of expediency. In some of these cases, even if the uterus can be completely reduced into the pelvis, the abdominal cavity may forcibly resent a reduction which is now really of the nature of an intrusion. Thus, in an elderly, very fat multipara resting in bed, in whom I reduced a very marked procidentia and accompanying large cystocele and rectocele, retaining the replaced uterus by rubber ring and tampons, the patient was very soon taken with violent vomiting, and peremptorily shot out ring, tampons, uterus, bladder, and bowel. In this case the prolapsed

organs formed a large tumor, suggesting a fetal head projecting between the labia, and the patient had no hope of getting into a chair without first forcibly reducing the protruding mass. In my experience these pronounced cases of procidentia have usually occurred in elderly, obese, breathless females, in whom abdominal section is apt to be fraught with difficulty and danger. At the same time, I have seen very pronounced procidentia in quite young women, one being only 23 years of age.

The performance of vaginal hysterectomy in these exaggerated chronic cases of procidentia may be attended with no little difficulty on account of dense adhesion of the bladder to the cervix, the rectum being also adherent, though to a less extent. The cervix may be much hypertrophied, the mucosa over the cystocele and rectocele greatly thickened, cutaneous, and ulcerated, and the supravaginal cervix remarkably lengthened and thinned out. Thus, in one case the sound passed 5 5 inches, the length of the body being 2 5 inches and the cervix 3 inches; the uterus could easily be drawn down to bring the fundus outside the vagina. In this case, vaginal hysterectomy was performed with an excellent after result. I noticed, in carrying out the operation, that the cardinal ligaments were a good deal increased in bulk instead of being attenuated as I had expected on theoretical grounds, to find them. The same thing was noticed in other cases, a fact I consider of much importance in regard to my operation of looping the cardinal ligaments. In vaginal hysterectomy the cardinals may be shortened (after removal of the uterus), the stumps should be sutured to the angles of the vaginal wound, while anterior and posterior colporrhaphy may be called for.

Realizing the difficulty of vaginal hysterectomy in pronounced chronic procidentia, Doyen has bisected the uterus, after opening Douglas' pouch, with the object of simplifying the operation and making it less dangerous.

As an alternative to vaginal hysterectomy, various abdominal operations have been carried out. Thus, the stump, after supravaginal hysterectomy, has been fixed in the abdominal incision. Again, J. B. Murphy has an operation of which he thinks highly. He cuts the round ligament, fallopian tube, and broad ligament away from the uterus by an incision close into the side of the uterus, and extending to the cervicocorporeal junction; ties the stump up and sutures it to this junction, and then sews the parietal peritoneum around the junction,

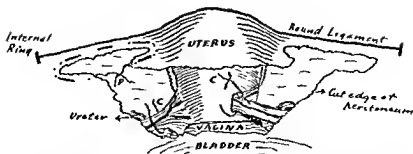


Fig 1 Indicating the operations of looping the cardinal ligaments, and restoration of the round ligaments. The uterovesical pouch has been freely opened up, and the bladder thrown down from the uterus and vagina. Ligatures are shown around the cardinal ligaments (c c) the ligament on the left being stitched to the front of the uterus. An incision parallel to the round ligament is to be closed by the purse string (p) to secure anteversion.

"thus leaving the body of the uterus bare and free, standing above the level of the divided recti." The uterus is then split, the endometrium dissected out, and each half of the uterus sewn down on the corresponding rectus aponeurosis. Here, it is clear, the uterus, through the medium of the cardinal ligaments, now pulls up the bladder and rectum. Murphy states that his operation can be done quite rapidly.

In considering the place of my operation (looping the cardinal ligaments) in cases of very pronounced procidentia, I found myself confronted with certain questions: (1) Is the patient a suitable subject for an abdominal section? (2) Will the abdomen tolerate the replaced uterus? If not, can it be reeducated by rest and local treatment to do so? (3) What is the limit of length of a procident uterus to which the operation can be successfully applied, assuming there are no other contra-indications?

Vaginal hysterectomy in these very pronounced cases of procidentia I had found rather difficult, while in some of the operations the more immediate after progress was marked by a good deal of pain, together with foul discharge from sloughing. So, too, although in my own cases the subsequent results as to comfort were good, other surgeons have occasionally found that the cystocele and rectocele have recurred. Thus, of course, may have been due to not stitching the stumps of the cardinal ligaments to the lateral angles of the vagina. All the same, I felt that, if I could substitute my own conservative procedure for a mutilating operation, I would be achieving a scientific victory. With this idea in mind I set out to consider to what extent the lengthened procident uterus might be shortened.

Removal of a big wedge from each lip of the hypertrophied cervix, the apex of the wedge extending up into the supravaginal cervix, would mean at least an inch of shortening. Removal of the wedges would, however, mean more than this, for experience has shown that in addition the uterus would be stimulated to contract. It is impossible accurately to estimate the extent of this contraction, but I believe that a shortening of the uterus by at least half an inch would be within the mark. It may thus be stated generally that removal of large wedges from the hypertrophied cervix of the procident uterus would finally bring about a shortening of at least one and a half inches.

However, in discussing the place of my operation, we are more concerned with the immediate than the final shortening. Assuming the procident uterus is found by the sound to be 5 inches long, removal of cervical wedges reduces the length of the uterus to 4 inches. Will a uterus of this length when fixed in the pelvis, cause trouble? I believed that it would not, and at the same time felt that in the course of some weeks when the uterus had contracted to 3.5 inches, the likelihood of trouble would almost certainly be eliminated. Rightly or wrongly I decided to make a provisional maximum of 5 inches length of a procident uterus as suitable for my operation of looping the cardinal ligaments on the lines indicated.

In practice I found the foregoing reasoning and conclusions apparently justified. Since, then, a procident uterus is rarely over 5 inches in length, it may be stated that my operation (looping the cardinal ligaments) will be found suitable for practically all cases, provided, of course, that there are no special contra-indications.

to the procedure. All the same, with a procident uterus with anything more than 4 5 inches long, the alternative operation (vaginal hysterectomy) should be fully considered. Looping the cardinal ligaments on the lines indicated usually involves two distinct sittings and several distinct operative procedures, while vaginal hysterectomy usually means only a single operation. After the menopause in obese, breathless females vaginal hysterectomy will be the safer operation.

In considering the question of curtailing the length of a procident uterus, it seems well to

point out that an immediate shortening of at least one and a half inches might be secured by an amputation of the supravaginal cervix. In the course of three or more weeks, when healing was complete, the abdominal part of the operation (looping the cardinal ligaments and restoration of the round ligaments) might be carried out, and the pelvic diaphragm repaired. By proceeding on these lines, procident uteri of over 5 inches in length might be satisfactorily dealt with. In the supravaginal amputation of the cervix the technique of Jellett is excellent.

THE ABUSE OF PITUITARY EXTRACT

By GEORGE CLARK MOSHER, A.M., M.D., F.A.C.S., KANSAS CITY, MISSOURI

THE most serious drawback to therapeutic progress is hasty immature generalization and the drawing of premature conclusions from faulty premises. In case of pituitary extract we have a remedy which is of undoubted value. Its place is distinct and definite. In a multipara whose case has been carried to the perineal stage of labor and stasis results, the question of the use of forceps arises, but the inertia can be met by a dose of pituitary extract by which the uterine inertia is overcome, and further aid is in a large number of cases unnecessary.

On the other hand pituitary extract has no place in normal labor, nor in a case where there is abnormality in presentation, nor where there is pelvic dystocia.

The reason for this assertion is that recently too many writers have made such sweeping statements regarding the virtues of pituitary extract that inexperienced practitioners are prone to be thereby led into grave disaster through general application of such means of powerful stimulation of uterine contractions to rapid delivery, and the result is that either mother or child suffers the consequences.

The writer was fortunate to have been invited to a meeting of the Obstetrical Section of the New York Academy of Medicine while in the East last fall. In a general discussion Dr S. W. Bandler, made the statement in criticizing scopolamine semimarcosis that, after depicting his ideas of the terrors of that method to his prospective patient, he would add that if she really wanted a quick and safe delivery he had

it in pituitrin. This was an unqualified statement. Dr J. K. Quigley of Rochester, N. Y., says, "No untoward (sic) results were noted in fifty cases and the greatest value is in the second stage but good results follow its earlier employment." To this last clause a demurrer should be emphatically entered.

At the old City Hospital in Kansas City last year a colored woman was brought in by the ambulance one night. She was reported to have been treated outside with repeated doses of pituitrin. My confrere, Dr Ritter, who was on duty was called, and diagnosed a transverse position. The woman was found to be moribund. She died in a few minutes. Post mortem revealed that the diagnosis was correct and also a ruptured uterus was found, the head and arm of the foetus extruded through the rent. No fault can be found with the remedy here. It did its work.

Ingraham and Chase have noted tetanic pains when any resistance to the advance of the child is met. In their cases the blood pressure rose twenty points, the fetal heart beat fell eleven beats. In thirty-three cases of which they kept records six children were born asphyxiated, two still born and three died soon after birth. Seven mothers had excessive post-partum hemorrhage. Imperfect notes of the death of seven infants in private practice have been collected where in the hands of good men, pituitrin was used early in labor, and no other apparent cause for the still birth existed.

Let us give this as every other good remedy praise for its beneficial effects, but let it be under-

stood that its sphere is a limited one, not applicable in primiparae, nor in dystocia, nor any case in labor except where a delay is met at the pelvic outlet, especially in multiparae.

Let the diagnosis be definite and the risks fully appreciated before it is decided to administer pituitary extract.

No remedy which has such a powerful effect is to be employed indiscriminately, as the wrong use will as surely give results as its proper administration. To the mother who has already had the test of labor, with an inability to deliver a head already on the perineum, it is a boon. To a primipara in the first stage it is a menace.

DOUBLE NUCHAL DISPLACEMENT OF ARMS IN A FOOTLING PRESENTATION, WITH BREECH ANTERIOR, CHIN CAUGHT ABOVE SYMPHYSIS PUBIS

By GORDON G. COPELAND, B.A. M.B., TORONTO, ONTARIO
Assistant Obstetrical Surgeon, Toronto Western Hospital

THIS combination of complications is, I believe, unique, and I think it worth recording. Double nuchal, or dorsal, displacement of the arms in a breech presentation is exceedingly rare. I have failed to find any mention of this condition in more than twenty standard textbooks consulted.¹ It is suggested by Cameron and Webster in *Jewett's Obstetrics*, but there the matter is vague. It is mentioned by Munro Kerr, who states the difficulties and the improbability of successful outcome. It is more fully discussed and well illustrated in De Lee's splendid work on obstetrics just recently published. My case was even rarer, and still more complicated.

CASE HISTORY AND COMMENTS

On February 12, 1915, I was telephoned to from the Western Hospital by the House Surgeon on Obstetrics, that an Irish woman of 29 years had come into the obstetrical department in labor that she was a primipara, the head was not fixed, and that the fetus seemed to be in a transverse or breech position. I hurried to the hospital and on examining the woman made out the following facts: There was a breech presentation with the breech not tightly fixed in the pelvis. The membranes had already ruptured spontaneously and the fetal heart could not be heard. No fetal movements could be made out. The uterus was tightly contracted on the child and the parts were hard to palpate. The woman was having strong pains every five minutes. No fetal parts showed at the vulva. I took the external pelvic measurements which were as follows: Anterior superior spines 24 cm., intercrural 27.5 cm., anteroposterior 18.5 cm., symphysis to umbilicus 14 cm., symphysis to fundus 24 cm., symphysis to ensiform 15 cm.

Nothing further of importance was made out by external examination. A vaginal examination showed the feet were at the vulva, and crossed so as to prevent farther

descent. The cervix was fully dilated and the cord was not prolapsed. I sent the woman into the delivery room and had her prepared for a breech extraction.

The pains increased in frequency and strength. I freed the feet and delivery went on apparently normally as far as the birth of the hips and unaided. The child was not dead, however, as I was able to prove, for on tickling the soles of the feet definite plantar flexion occurred and the toes moved. The sacrum came down looking anterior and to the woman's left (sacrum left anterior) as far as the umbilicus whereupon I pulled down a loop of the cord which was pulsating very feebly and was difficult to draw down as the maternal outlet was very small, and quite filled by the body of the child. No traction had been made thus far and the exposed parts were covered with a towel wrung out of warm water both sterile of course. I now had the house surgeon make abdominal pressure, with the pains which had now increased in frequency to every two minutes. The woman had been put under light ether anaesthesia. The thorax did not descend, however, in spite of the pains and the fundal pressure. So I made another internal examination to ascertain the cause of the delay. I put my sterile gloved hand along the body of the child (a very difficult task owing to the lack of room). I could not find the arms, and was puzzled to find the hands beside the head. Traction on these produced no effect and on deeper palpation I discovered that not only were the arms crossed behind the neck, a double nuchal displacement, but that the thorax was partially turned. The shoulder girdle more so, and the head completely turned so as to face the front and wedged tightly above the symphysis pubis. Thus the face and the sacrum looked almost in the same direction (Fig. 1). The reason for the delay was amply demonstrated. The pains and the fundal pressure could not have driven the child down any farther. The uterus was tightly contracted down on the head, arms and shoulders. Though immediate attempts were made to rotate the body in the hope of disengaging an arm, the lack of liquor amnii and the contracted uterus prevented the head turning when the body turned nor could the fetus be pushed up as a whole for the same reasons. Attempts to get my hand up high enough to get well at the arms were futile owing to the lack of room as every attempt crushed in the chest of the child. I had the anaesthetic deepened in the hope that the uterus would relax. It did not relax. The child died at this stage.

¹ Tweedy and Wrench: *American Text Book of Obstetrics*. Luck, Portland. Lewis: *Granville Jarman and Marx*. Galloway: *Jelliffe*. Evans: *Wright*. Jardine: *Reynolds* and *Newell*. Williams: *Berkeley* and *Bonney*. Hunt: *Edgar*. Eden: *Davis*.



Fig 1 Drawing illustrating condition found. Uterus drawn in too relaxed purposely to demonstrate the parts more clearly. The arms were actually much tighter around the neck. The maternal soft parts were tight around the body as far down as the lower part of the thorax.

I now made more strenuous efforts to get up my hand (which takes a 7½ glove) and this crushed in the thorax of the child considerably. After a great effort, I succeeded in getting down the right arm, but not before I had fractured the humerus and dislocated the shoulder, so tightly were they wedged. I then got down the other arm. My hands by now were so paralyzed that I could not get at the mouth to turn the head, for the uterus had at once contracted on the head which would not turn when the body turned. I now asked the house surgeon to try if he could turn the head. He tried several times unsuccessfully, and I was about to perforate the aftercoming head when he asked if he might try again, and this time succeeded. The further delivery of the head was not very hard. Only slight mucous membrane tears had resulted and these were repaired with iodized catgut. The placenta and membranes were expressed in a few moments by the Rotund method. The child weighed only 7½ pounds and the head was not unduly large, but, turned as it was, and thrust forward by the arms around the neck, it was relatively too large to get out of that pelvis in that position. The patient made an uninterrupted recovery.

Had the patient been seen before the membranes ruptured, a podalic version could have been attempted and the case left to Nature to go on as a vertex case, or forceps applied, since there was good reason to believe, from the pelvic



Fig 2 Redrawn reversed (from De Lee, Fig 843) to correlate with Fig 1. This position is second only in rarity to the position found.

measurements, that the bony outlet was not contracted, for a breech extraction of a full term child through the undilated soft parts of a primipara entails considerable risk to the child even without the above complications.

De Lee illustrates well double dorsal displacement of the arms (Fig. 2), and says that the position is very difficult to correct. My case was infinitely harder, and could not be palpated externally. While the X-rays could have shown the condition readily enough, this was not feasible.

Before the woman left the hospital, I examined her carefully and could find very little abnormal, except that the subpubic arch was narrower than normal and hence manipulations were harder and more tiring to the hand than in an ordinary case. I have not been able to find any mention of a similar case, nor can I satisfactorily explain the mechanism of this position, though I might suggest that the pain caused the child, whose legs became crossed and crushed as the body was driven down on the legs by the uterine contractions, to turn its body and head around, and the uterus contracting more tightly had prevented a restitution to the original position.

I could see no reason why the woman should not subsequently go through a normal delivery.

SELF-RETAINING DRAINAGE TUBES

BY AP MORGAN VANCE, M.D., F.A.C.S., LOUISVILLE, KENTUCKY

THE question of draining pus, blood, serum, etc., from surgical wounds and from the body cavities, has been discussed since the beginning of surgical history. In elective surgery, i.e., in uninfected or so-called "clean" cases in private hospitals, where the patient can be subjected to the requisite pre-operative preparation, where complete asepsis can be maintained during and after the operation, drainage is rarely required. However, in cases in which these desiderata are unattainable and in all infected cases, the question of drainage must be considered.

For many years there has been sought a satisfactory method of drainage which could be made applicable to all classes of surgical wounds regardless of the anatomical situation, and

applicable as well to the various body cavities for the liberation of infective material, and which at the same time would overcome the objectionable features attending some of the plans in vogue.

It has long been recognized that the most suitable method for securing adequate drainage is by means of rubber tubing of proper size and fenestrated as desired. However, there has been devised hitherto no satisfactory plan for maintaining the tube in position without, to a certain extent, limiting its effectiveness and at the same time interfering with wound repair from necessary readjustment during subsequent dressings.

With the idea of overcoming these objectionable features, the writer recently evolved a plan by which the drainage tube may be made practically self retaining by a series of mechanical alterations as shown in the accompanying illus-



Fig 1 Shows rubber tube with one tongue pulled through the other being grasped by the hemostatic forceps ready to be pulled through

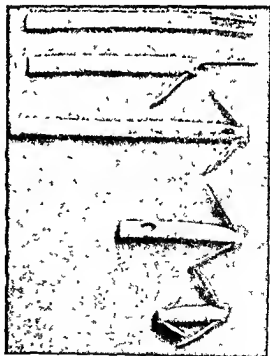


Fig 2 Shows the tube in the various steps of the procedure

trations The manner of preparation is briefly as follows:

1. Select a pure rubber tube of the proper size, cut it two inches longer than required for the wound or cavity to be drained, and make as many fenestra in the distal portion as desired.

2. About two inches from the proximal end make two horizontal openings, by snipping with scissors, sufficiently wide to accommodate the tongues next to be described

3. With scissors, split the proximal end of the tube to within half an inch of the horizontal openings already described, and make a tongue tapering slightly from tip to base, upon each side

4. Insert small hæmostatic forceps through the horizontal opening and grasp the tip of the tongue, pulling it downward into the tubal lumen and outward through the opening until the base or wider portion fits snugly into the aperture

5. When both tongues have been thus drawn through the horizontal openings, the result will be a tube the lumen of which has not been reduced in the slightest although the rubber is double for a quarter of an inch proximal to the tongues

When the tube is inserted into the wound or cavity to be drained, it is so placed that the two tongues forming the arms of the "T" are at right angles to the incision and flat upon the external surface of the body. These arms are

then held in position against the body surface by narrow strips of adhesive plaster, over which the outer dressings are applied. When securely fastened in this manner, the tube can neither slip outward nor inward, and the objectionable safety-pin or suture for anchoring the tube is avoided. The dressings may be changed as frequently as necessary without disturbing the tube or interfering with the mechanism of drainage.

When prepared and anchored in the manner described, the rubber tube may be successfully employed in any anatomical situation where drainage is required.

Where prolonged drainage becomes necessary in lesions of the chest, bladder, etc., as an additional precaution against the tube slipping in either direction, tongues may be made in similar manner at the distal end by cutting the tube the proper length. The distal tongues are held within the tubal lumen by small hæmostatic forceps during insertion of the tube, and after being released and pushed from the tubal lumen the "T" shape is assumed within the cavity, thus being a self-retaining drain which is oftentimes much desired, as in drainage by the vagina, or bladder either above or below, also in drainage in the chest as already mentioned.

Study of the accompanying illustrations will give the reader a better conception of the almost universal application of the idea than any description can do.

A ZIGZAG PURSE-STRING SUTURE FOR GALL-BLADDER WORK

BY W. H. WILLIAMS, M.D. F.A.C.S., LEBANON, INDIANA

IN doing gall-bladder surgery I have found a number of cases in which the cut edge of the gall-bladder presented annoying hemorrhage, and in others the attempt at inversion presented some difficulties with the usual purse string suture. Also in those cases where the drainage tube was attached to the free edge by a stitch and inversion thus made, there was a tendency

carried up to near the edge, then out, then laterally one-fourth inch, then in, then down to a point on the same level with the first insertion, then out, then laterally one-fourth inch, then in, then up the same distance as before, then out, then laterally, and then the same routine until the opposite side of the tube from the first insertion is reached, when the lower angle of the suture

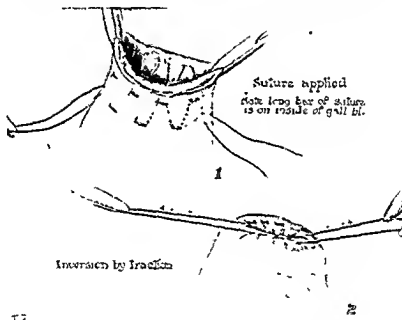


Fig. 1 (1) Suture applied long bar of suture on inside of gall bladder (2) Inversion of suture by traction

on the part of the edges to roll outward again when slight tension was made on the tube. To avoid these difficulties I have adopted the suture shown in the drawing which I have chosen to call the "zigzag purse string suture."

The stitch can be of whatever suture material the operator may find best to use in each given case. Aside from gall bladder work it can be used in intestinal or any work dealing with parts that are thin walled and tubular.

It has two advantages, viz., hemostasis and inversion of the cut edge, thus giving approximation of peritoneal surfaces. If done with a straight needle it is thrust in through the entire wall then

is grasped with forceps to be used as tractors. From here the same process is continued to the point of starting. With a curved needle the in and out puncture can be made at one thrust and in some cases is better. The length of the vertical part of the stitch is determined by the amount of tissue to be turned in and, because of the "brace effect" of this part, the edge always inverts when traction is made on the forceps and the two ends which are tied after the forceps have been released and the slack taken up in the suture. This is applicable to cases with or without drainage and will be found a very dependable type of suture to use.

AN IMPROVED SUBSTITUTE FOR IODIZED CATGUT SUTURES

By CASSIUS H. WATSON, B.S., M.D., BROOKLYN, NEW YORK

THE iodization of catgut sutures has as its aim the impregnation of the suture with a substance which will cause the implanted suture to exert a local antiseptic or germicidal action in the tissues. Experience has shown that the use of iodine, while to a certain extent fulfilling this requirement, presents serious disadvantages, animal suture material treated with metallic iodine suffers a loss in tensile strength and produces more or less local irritation when implanted in surgical wounds. Further, sutures so treated deteriorate immediately when subjected to heat, thus making it impossible to boil the glass tubes in which the various preparations of iodized gut are usually supplied.

In order to obviate these difficulties, a search has been made for a chemical substance possessing great germicidal potency and low toxicity with no irritant action, which is stable when subjected to sterilizing temperatures, and which will not impair the strength of the suture material. Macfarlan¹ has recently recommended potassium mercuric iodide as a substance which shows marked germicidal action in great dilutions and a remarkably low toxicity for its strength. This salt has long been known as a bactericide, but its value apparently has not been fully appreciated. Macfarlan states that its solutions are stable, the drug may be taken internally in doses of five drops of a one per cent solution without toxic effects, a one per cent solution has but slight irritant action, and a dilution of one to eighty thousand, or nearly one-thousandth of one per cent, exhibits marked germicidal powers.

In view of Macfarlan's findings it was felt that this double salt of iodine might be used to great advantage in the impregnation of catgut sutures since it fulfilled so completely the necessary conditions. Therefore, the present experiments were undertaken to test its applicability to the preparation of sutures. Macfarlan determined the germicidal strength of his dilutions by the method suggested by Park.² In the present experiments, however, in order to submit the solutions to tests which would represent conditions far more exacting than those actually existing in the handling of sutures, the following procedure was carried out:

1 Strands of prepared catgut No. 2, cut in one centimeter lengths, were sterilized for one hour at 160° C., then immersed for five minutes in twenty-four hour old cultures of staphylococcus pyogenes aureus (representing the pus-producing cocci), bacillus coli communis (representing the intestinal bacilli), and bacillus subtilis (representing sporulating bacilli such as the bacilli of anthrax and tetanus). The strands were then rapidly dried over sulphuric acid and phosphorus pentoxide in a vacuum desiccator. The dried inoculated catgut was then immersed for ten minutes, one hour, six hours, and twenty-four hours respectively, in solutions representing varying concentrations of iodine and potassium mercuric iodide. At the end of the various immersion periods the strands were removed from the germicidal solutions, washed in sterile water, and planted in tubes containing five cubic centimeters of nutrient broth. The tubes were incubated for four days at 37° C. All tests were made in duplicate. The method was controlled by immersing dried inoculated gut in sterile salt solution and planting in broth, and also by culturing the dried sterile gut. The results are shown in the following table.

THE ACTUAL AND COMPARATIVE GERMICIDAL ACTION OF ALCOHOLIC SOLUTIONS OF IODINE AND POTASSIUM MERCURIC IODIDE

MICROORGANISMS TESTED

Germicidal Solutions Staphylococcus pyogenes aureus

	Concentration	10 min.	1 hr.	6 hrs.	24 hrs.
Iodine	1:100	XX	XX	00	00
Iodine	1:250	XX	XX	00	00
Iodine	1:500	XX	XX	00	00
Potassium mercuric iodide	1:500	XX	XX	00	00
Potassium mercuric iodide	1:1000	XX	00	00	00
Potassium mercuric iodide	1:5000	XX	XX	XX	00
Sterile NaCl solution	0.9%	XX	XX	XX	XX

Germicidal Solutions Bacillus coli communis

	Concentration	10 min.	1 hr.	6 hrs.	24 hrs.
Iodine	1:100	00	00	00	00
Iodine	1:250	00	00	00	00
Iodine	1:500	XX	XX	00	00
Potassium mercuric iodide	1:500	00	00	00	00
Potassium mercuric iodide	1:1000	00	00	00	00
Potassium mercuric iodide	1:5000	00	00	00	00
Sterile NaCl solution	0.9%	XX	XX	XX	XX

Germicidal Solutions Bacillus subtilis

	Concentration	10 min.	1 hr.	6 hrs.	24 hrs.
Iodine	1:100	XX	XX	XX	XX
Iodine	1:250	XX	XX	XX	XX
Iodine	1:500	XX	XX	XX	XX
Potassium mercuric iodide	1:500	XX	XX	XX	00

¹ Macfarlan: D. Notes in the study of potassium mercuric iodide. J. Am. M. Ass. 1914, LXII, 17.

² Park: W. H. and Williams: A. W. Pathogenic Microorganisms, fifth edition, p. 638. New York: Lea & Febiger, 1914.

Potassium mercuric iodide	1 1000	xx	xx	xx	oo
Potassium mercuric iodide	1 5000	xx	xx	xx	xx
Sterile NaCl solution	0 9%	xx	xx	xx	xx
x=growth o=no growth					

Average increase in strength of potassium mercuric iodide catgut over plain catgut 1 78 pounds—6 5 per cent

Average increase in strength of potassium mercuric iodide catgut over iodized catgut 4 5 pounds—16 5 per cent

The above results show that, under the conditions of the test, a one to one-thousand solution of potassium mercuric iodide will kill *Bacillus coli communis* in ten minutes, *Staphylococcus pyogenes aureus* in six hours, and even the sporulating *Bacillus subtilis* in twenty-four hours. It will be seen that this strength of potassium mercuric iodide is superior in its germicidal action to a one to one hundred solution of iodine. When it is borne in mind that the catgut used in the test had been soaked in vigorous cultures of the three organisms before immersing in the disinfecting solutions, it is evident that a one tenth of one per cent solution of potassium mercuric iodide would effectually sterilize sutures which had been contaminated in such handling as that received in the operating room. Since, in such a dilution, it is entirely free from any irritant or toxic action, it would seem that this salt is to be greatly preferred to iodine.

Having determined its bactericidal efficiency, tests were made on the influence of potassium mercuric iodide solutions on the tensile strength of various sutures. Samples of catgut sutures of various sizes (Nos. 1, 2, 3) were carried through the process used in the preparation of iodized catgut, substituting a one per thousand alcoholic solution of potassium mercuric iodide for the iodine solution ordinarily employed. Comparative physical tests were then made on the sutures thus prepared, on sutures iodized in the usual way, and on ordinary catgut. The figures in the following table represent the average of ten tests on each size.

TENSILE STRENGTH OF PLAIN, IODIZED AND POTASSIUM MERCURIC IODIDE CATGUT SUTURES

Sut.	Plain Sterile Catgut	Iodized Catgut	Potassium Mercuric Iodide Catgut
000	9 pounds	7 5 pounds	11 pounds
00	12 5 pounds	10 5 pounds	15 5 pounds
0	20 5 pounds	17 pounds	21 pounds
1	26 pounds	23 5 pounds	27 pounds
2	33 pounds	32 pounds	34 5 pounds
3	41 5 pounds	38 pounds	43 pounds
4	48 pounds	45 pounds	51 pounds

The results of this series of tests are striking. The figures for iodized catgut bear out the statement made above concerning the detrimental action of iodine on suture material. On the other hand, the substitution of potassium mercuric iodide for iodine not only obviates this disadvantage but actually increases the tensile strength of the catgut strands, so that sutures so treated withstand an appreciably greater strain than do the plain grades.

A decided objection to the iodization of catgut is the effect produced on such gut by boiling the tubes for the purpose of sterilizing them preparatory to an operation. The gut shrinks and shrivels and is rendered unfit for use when subjected to the temperature of boiling water. This necessitates a recourse to chemical sterilization which is less convenient. It was hoped that sutures impregnated with potassium mercuric iodide would not be affected when subjected to boiling in sealed tubes. Tests were made by tubing sutures so impregnated in chloroform and then placing the sealed tubes in boiling water for five minutes. It was found that, while the iodized gut shriveled, the potassium mercuric iodide gut remained unaffected.

CONCLUSIONS

1 Potassium mercuric iodide, in alcoholic solution in a dilution of one to one thousand, has more than ten times the germicidal efficiency of one to one hundred solution of iodine in alcohol.

2 The impregnation of catgut sutures with potassium mercuric iodide, by increasing the tensile strength of the gut, offers a distinct advantage over the similar use of iodine.

3 Catgut sutures impregnated with potassium mercuric iodide, when sealed in tubes with chloroform, show no deterioration when the tubes are subjected to boiling. Since iodized sutures are ruined by such treatment, the superiority of potassium mercuric iodide over iodine as a germicidal impregnating agent is obvious.

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JANUARY, 1916

ENDOWMENT OF AMERICAN COL- LEGE OF SURGEONS

THE American College of Surgeons begins the new year with an announcement that it has secured from its Fellows an Endowment Fund of \$500,000. This fund is to be held in perpetuity, the income only to be used to advance the purposes of the College. By this means lasting progress toward the aims of the College is assured.

The College, which is not a teaching institution but rather a society or a college in the original sense, now lists about 3,400 Fellows in Canada and in the United States. With out precedent for swiftness of development it stands today a powerful factor both in the art and in the economics of surgery.

Primarily the College is concerned with the training of surgeons. But the significant fact in connection with the endowment just secured is that it has come from the surgeons themselves, inspired by a motive for better

service to the patient. Ideals in the profession of medicine are living things. Probably no more convincing proof of this fact exists than the sacrifice which the surgeons of this continent have made willingly in order to raise this fund.

To begin with, these ideals are to find concrete expression along the following lines of activity.

1 Since the whole problem of the training of specialists for the practice of surgery is the primary purpose of the College, the Regents propose at an early date to present a clear conception of the College to the undergraduate medical students of this continent. The Regents, further, will ask each senior student of this group who has in mind to specialize in general surgery or any branch of surgery to register with the College. As these students, then, serve later as internes and as surgical assistants, they will be requested to report these facts to the College. The College, in turn, will systematically seek information as to the ability and character of such men, and the information thus obtained becomes the basis of admission to fellowship in the College. In addition to this procedure, the Regents will insist upon the proper keeping of case histories, and they will endeavor to stimulate in these men in training, right ideals of medical practice. In this program they ask the active cooperation of the faculties of the medical schools and of all practitioners of medicine.

2 Inasmuch as proper training in surgery is inseparably involved with the conduct and efficiency of hospitals, the College will seek accurate data on all matters which

relate to hospitals. From time to time it will publish studies upon hospital problems, the purpose being always to be helpful to the hospitals. These publications, further, will inform recent medical graduates as to where they may seek adequate general or special training in surgery. To be concrete the College will deal with such problems as (a) the proper equipment for medical diagnosis, e.g., well equipped laboratories for chemical, pathological, and X-ray work, (b) the proper forms for case histories and the facilities for keeping these records, (c) the management and the curricula of the nurses' training schools, (d) the specialization essential in any well organized hospital.

3 The College will ask the faculties of medical schools to consider the advisability of conferring a supplementary degree of proficiency in general surgery and in the various specialties of surgery.

4 The College will issue readable monographs, educational in nature to the press, to the general public, to hospital trustees and to the profession of medicine upon subjects of medical procedure and the whole meaning of fitness to practice surgery.

The entire impetus of the College springs from within its own membership. Necessarily that impetus implies reform. But there is a vast difference between reform preached at men and reform innate in the hearts of men which finds expression at their own initiative. Whatever impetus the College possesses, it originates among the surgeons themselves. It is not an extraneous force or an "uplift" movement. But rather out of the widely divergent views on many subjects among the Fellows the aims of the College rise as those time tried aspirations which are inherently the basis of all that is valuable in the vocation of surgery. The purposes of the College are concerned directly

with matters of character and of training, with the betterment of hospitals and of the teaching facilities of medical schools, with laws which relate to medical practice and privilege, and with an unselfish protection of the public from incompetent service, in a word, they embody those ideals which have stood the test of centuries. Upon these the Fellows are united. These are the ideals which each Fellow, single handed, has endeavored to foster, and the expression of them today through the College comes as a sort of mass-consciousness of the whole body of Fellows. The splendid fact is that the Fellows have grasped in an instant the meaning of the College by a process of fusion and they have gladly made sacrifices for its success.

As one comes into wide acquaintance with the Fellows of the College and catches some fair notion of their earnestness, he sees the future of the organization not by means of logic. There is something more subtle and potent than argument. A determined optimism carries a momentum of its own. Without a logical process it seeks concrete expression, and, more than this it really recreates circumstances through all shifts of weather or play of incident with a certainty not excelled by an utterly rational course. The Fellows of the College in their widely scattered districts fuse their consciousness of the organization with a splendid hope in their hearts to advance all that is important and valuable in the profession. This very attitude of mind is the first promise for the future of the College. It is a promise that admits of no defeat. It is a pledge of loyalty to medical patriotism which means loyalty to the public welfare exercised through intellectual sincerity and scientific accuracy. It means a safeguard to the public, for it indicates where honest and adequate surgery may be found.

JOHN G. BOWMAN, Director

TRANSACTIONS OF SOCIETIES

CLINICAL CONGRESS OF SURGEONS OF NORTH AMERICA

THE sixth annual session of the Clinical Congress of Surgeons of North America, held in Boston October 25th to 29th, 1915, served to emphasize the importance and popularity of these annual clinical meetings. Fifteen hundred surgeons were in attendance, representing practically every state in the United States and every province in Canada. The importance of Boston as a clinical center is so generally recognized that it was quite apparent that a clinical meeting in that city would attract large numbers of surgeons and it was, therefore, decided to limit the attendance to a number that could be comfortably cared for. This established a precedent for medical meetings in America. The plan worked out most advantageously, though a considerable number of surgeons who made application for membership at a late date were disappointed when their applications and fees were returned, due to the fact that the limit of membership had been reached some weeks in advance of the meeting. The rule established at the Boston meeting will control at future meetings of the Congress.

The success of the meeting in Boston—and it must be conceded that it was a success in every way—can be attributed to the well considered plans of the Committee on Arrangements, backed by the splendid team work of the Boston clinicians who entered into the work enthusiastically to the end that there might be a complete demonstration of Boston's clinical facilities.

The following institutions participated in the clinical program

Massachusetts General Hospital,
Boston City Hospital,
Children's Hospital,
Massachusetts Homeopathic Hospital,
Peter Bent Brigham Hospital,
Free Hospital for Women,
St. Elizabeth's Hospital,
Robert Brigham Hospital,
New England Hospital for Women and Children,
Long Island Hospital
Carney Hospital,
Codman Hospital,
House of the Good Samaritan,
Massachusetts Charitable Eye and Ear Infirmary,
Huntington Memorial Hospital,
Infants' Hospital,
Boston Dispensary,

Forsyth Dental Infirmary,
Harvard Medical School
Tufts Medical School

The programs for the evening sessions—the general surgical section in the ballroom of the Copley Plaza, and the division of surgical specialties at the Boston Medical Library and Harvard Medical School—attracted large audiences. Of the papers read at these meetings several appear in this issue and others will be published in later numbers.

THE ANNUAL MEETING

At the annual meeting held in the ball room of the Copley-Plaza on Thursday, Dr Emory A. Codman of Boston presented the report of the Committee on Hospital Standardization, which report is published in this number (see page 119). The report was discussed by Dr Edward Martin of Philadelphia, Dr Horace G. Wetherill of Denver, and Dr J. A. Hornsby of Chicago.

Dr John Wesley Long of Greensboro, N. C., offered resolutions in support of the First Aid Conference as proposed by Dr Joseph C. Bloodgood of Baltimore in a report which will be found in the following pages.

For the Cancer Campaign Committee, Dr. Edward Reynolds of Boston, a member of the American Society for the Control of Cancer, presented a résumé of the work done along the line of publicity among the laity.

The following officers were elected

President, Fred B. Lund, Boston

First Vice-President, Jasper Halpenney, Winnipeg

Second Vice President, S. M. D. Clark, New Orleans

Secretary General, Franklin H. Martin, Chicago

Treasurer, Allen B. Kanavel, Chicago

General Manager, A. D. Ballou, Chicago

Philadelphia was selected as the meeting place for the 1916 session, to be held probably in October. An early announcement will be made in this journal as to the tentative plans for the next session, together with the selection of the Committee on Arrangements.

REPORT OF COMMITTEE ON HOSPITAL STANDARDIZATION

By I. A. CODMAN, M.D., CHURMAN

Your committee in previous reports¹ has stated its belief that a fair standardization of a hospital is impracticable unless the hospital to be standardized has some method of following up its end results. We believe that we have succeeded in bringing this idea to the attention of most of the hospitals of this country, and from many of them we have received expressions of interest. Two years have elapsed and we believe that it is now possible at least to make a preliminary classification into —

1. Those that care to make an effort to find out what kind of results they are getting
2. Those that do not care to

We believe that most people will agree that we have properly labeled these classes as 1 and 2 rather than the reverse. But is it the business of this Congress to find out which is which? Your committee dreads the odium of placing any hospital in Class 2. We think that some organization representing all branches of the medical profession should make this step across the Rubicon for all other forms of treatment. Inside surgical have good and bad results and it is possible to compare and record these results.

We have therefore been content to try to interest the medical public in the end result system, and to leave each hospital its chance for another year to step into Class 1.

Fortunately, the Committee on Arrangements of this meeting in Boston has come to our aid in the matter of giving further publicity to the end result idea. A year hence a report will be sent to each of you of the 'end results' to date of each case operated on before you during the week of this Congress. You have only to note the number of the case posted in the operating room at the time of the operation, and at the next meeting of the Congress to refresh your memory of the operation by looking at the abstract in the report together with a note on the success or failure of the operator to relieve the symptoms from which the patient suffered.

We believe that the adoption of this method in all teaching clinics will be of the greatest service both in graduate and undergraduate instruction.

We feel under great obligations to the Boston Committee on Arrangements and to the clinics at the Boston hospitals for this support of our policy in advocating the use of the *result to each individual patient* as the most important unit in the standardization of hospitals.

We wish to call your attention to some other important examples of the practicability of the 'follow up' and 'end result' systems which are to be found in the Boston clinics, especially at the

Massachusetts General, Boston Dispensary, and Carney Hospitals. In some of the corollaries of the end result system we find that important steps have been taken. The last annual report of the Massachusetts General Hospital deserves special study for it gives us an example of a hospital whose organization is strong enough and whose *esprit de corps* vigorous enough, to permit the use of a 'surgeon's card' on which each member of the surgical staff authoritatively records his own errors in diagnosis, skill, judgment, and care.

At this hospital, too, the policy of the assignment of special groups of cases has been successfully carried out. This plan assures the efficiency committee of a weapon to use in dealing with any class of cases which by the end result cards is shown to have a low percentage of successful results. It gives them also a sure method of testing the skill, judgment and original capacity of the members of the staff while at the same time assuring the patients of the hospital of always getting better and better results. In a hospital where such a system prevails, a young surgeon may well feel confident of rising to the top without leaving his path marred by the regrettable errors which many of us have unavoidably made under the old system where the calendar alone dictated what cases should come under our care.

We are interested also in this published statement of the Massachusetts General Hospital.

Resolved that in making appointments the trustees will consider the fitness of the applicant for the special services which he will be called on to perform, and will seek to secure the best service available without being bound by any custom of promotion by seniority.

These things may seem to the uninitiated to be small matters for this well known institution to have accomplished but in the opinion of this committee they are most important steps in the progress of helping the medical profession to free itself from some of the serious faults for which it may be criticized.

However we cannot help regretting that the trustees of this great hospital have not shown a willingness to bear part of the burden of the professional staff by appointing one of their members on the Efficiency Committee.

In our previous reports we have dwelt on this point with especial emphasis for we believe that hospital trustees are primarily responsible for therapeutic efficiency as well as for efficiency in other departments. We believe that a layman can ask 'Was this patient relieved of his symptoms? If not why not?' and judge fairly well whether the surgeon who operated and the super-

¹ Surg. Cyane & Oliver, 1914 January p. 6

tendent give him reasonable answers. If this can be done for the individual patient it can be done for classes of patients. We hold that the mere presence of a trustee on this committee to ask sensible questions *would be a point of the greatest importance in correcting hospital abuses.*

It would be an interesting medicolegal point to know whether a suit for malpractice would have more chance for success in —

1 A hospital in which no Efficiency Committee exists

2 A hospital in which the Efficiency Committee is entirely composed of the staff

3 A hospital in which one of the trustees or his authorized delegate serves on the Efficiency Committee

While the trustees shield themselves by appointing staffs with 'reputations' and do not look into the question of their 'efficiency' no wonder the laity choose their own doctor by what their neighbors say. This drives every doctor to care more for his 'reputation' than his 'efficiency' and tempts him to spend his time in concealing his ignorance rather than increasing his knowledge.

Boston and Massachusetts have also set us another example. The State Medical Society two years ago appointed a committee consisting of Drs. Homer Gage, Lincoln Davis, Pier Johnson, P. E. Truesdale, and J. T. Bottomley to ascertain from each hospital in the Commonwealth 'two things: (1) What person or department of the hospital is held responsible for its standard of therapeutic efficiency? (2) Would each hospital agree to a uniform system of morbidity report?' Most satisfactory answers were received and the committee is now working to obtain some simple form of report which all will agree on.

If the hospitals of Massachusetts are able to set an example in publishing reports based on some uniform system other states will certainly fall in line, and the country may well be grateful for the pioneer work of the above mentioned committee which has already more than half accomplished its task.

We have to offer you a printed form which can readily be used by any hospital having an end result card catalogue. This form can be obtained from Thomas Todd & Co., 14 Beacon St., Boston. In any hospital in which the end result cards have been introduced by the staff it will be a simple matter to fill out this form, which will serve as a permanent index of diseases and operations according to a primary pathologic and anatomic classification.

To the Boston Dispensary we are also much indebted for an advanced example of the principles of scientific management applied to dispensary work. To its director Mr. Michael M. Davis, Jr., acknowledgment is due as the first to call attention to the value of follow up systems in diminishing hospital waste products.

The report of this committee would be incomplete

did it not call your attention to the splendid work toward hospital efficiency which has been accomplished by Dr. Edward Martin of Philadelphia to whom more than to any man belongs the credit (and the onus) of going straight to the root of the problem by insisting that the next step in hospital organization must be one which will mean a standardization of the work of the professional staffs as well as of all other departments.

Through the efforts of Dr. Martin and Dr. Clarke in Philadelphia, a powerful committee on hospital efficiency has been formed with representatives from the important medical societies, educational institutions, and the State Board of Health. Those of you who are interested in hospital work should read the report of this committee which may be obtained from Dr. Edward Martin, 1506 Locust St., Philadelphia.

In closing our report we wish to call your attention to two paragraphs in our first report:

"That each of us do what he can to induce the trustees of his own hospital to organize a follow up system for all patients treated.

"That each of us do what he can to induce the fellow members of his staff to appoint Efficiency Committees who may look into the present conditions in his own hospital in order that we may as far as possible do our own housecleaning. Such Efficiency Committees should be composed of a member of the trustees, a member of the staff, and a superintendent. If tracing the results to the patients is equivalent to auditing the accounts, the trustees should take a hand in it."

Each member of your committee, feeling that example goes farther than precept, has done what he could in his own community, but the committee unanimously feels that the work which they have begun should in future be carried out by the more completely organized medical associations, namely, the American Medical Association or the American College of Surgeons. There is still hope that the Carnegie Foundation may aid in this matter.

We feel that in the leaflet which we have distributed we have offered a practical suggestion which is simple and inexpensive enough to be within the means of any hospital large or small. To carry the plan out, simply requires the cooperation of the staff, the trustees and the administrator.

We feel sure that the plan we recommend is so simple that any hospital staff which is really in earnest about improving the efficiency of its hospital can certainly do so by means of it.

We have no authority to command or ask the adoption of this system in any hospital, but we can and do suggest it. You are a representative body of men from all parts of the country, if our suggestion and Boston's example seem to you desirable, carry them home with you.

E. A. CODMAN, *Chairman* J. G. CLARK
W. J. MAYO ALLEN B. KANAVEL
W. W. CHIPMAN

FIRST AID TO THE INJURED

A SURVEY OF THE PRESENT EXPERIENCE AND PREVAILING OPINION AS TO THE TREATMENT OF ACCIDENTAL WOUNDS IMMEDIATELY AFTER THE INJURY

By JOSEPH COLT BLOODGOOD, M.D., F.A.C.S., BALTIMORE, MARYLAND

At the meeting of the American First Aid Conference in Washington, D. C., August 23 and 24 1915, a resolution was passed instructing the secretary to make a survey of the opinion and experience of surgeons throughout the United States and Canada on the more important questions in first aid. The following five questions were submitted to the Conference and, after discussion, the secretary was instructed to send these questions to surgeons in the United States and Canada.

The questions thus sent out are as follows:

1. What has been your experience with the most available first aid package and dressing for small and large wounds?

2. What has been your experience with the immediate employment of antiseptics in accidental wounds? what antiseptic have you used in what strength and how applied? Have you employed tincture of iodine if so, how and what have been the results?

3. What in your experience has been the most efficient and most readily applied method of fixation for injuries of the (a) upper and (b) the lower extremity?

4. Have you considered the construction of a stretcher which in addition to serving as a means of transportation of injured will have appliances for the fixation of the upper and lower extremity somewhat along the lines of a Bradford splint or the Stokes naval splint?

5. Please state your views on some liquid ointment dressing which would be available for first aid in large wounds and burns with the object of preventing the usual dry gauze dressing adhering to the wound and rendering subsequent dressings painless.

The First Aid Conference was a meeting of railroad surgeons, principally chief surgeons, general officials of railroads chiefly from the Claim Department, representatives from the Medical Departments of the Army, Navy, Public Health Service and the National Red Cross Society, a few civil surgeons representing national surgical associations, and representatives of manufacturers of first aid supplies.

The topics given out for discussion were somewhat as follows:

1. Is it a good scheme for railroads, mines and manufacturing concerns to furnish their employees first aid material and to instruct them on first aid methods? That is, shall we in time of peace prepare for accidental injuries in a somewhat similar manner as in time of war we furnish the soldier with first aid dressings and give him a certain amount of instruction in dressings, in immobilization and in transportation on stretchers?

Is a first aid scheme of this kind practical to be uniformly employed throughout a great railroad system and can it be carried further to all industries and still further—to the home?

2. If a first aid scheme of this kind is to be introduced throughout a railroad system and into other civic environments shall there be adopted the material employed in the Army and Navy, and shall the instructions be the same?

3. What is the best first aid dressing or package for simple wounds of different sizes, for larger gun shot wounds, for burns of different types?

4. What is the best fixation material to hold the dressing in place?

5. Shall an antiseptic be placed in the first aid package with instructions to the layman how to use it?

6. What about the tourniquet bandage or the tommyquet? Shall this be discarded from the first aid kit and the layman no longer be taught the anatomy of blood vessels and the simple schemes of checking hemorrhage?

7. What shall be done to provide for the fixation of fractures and the immobilization of upper and lower extremities for other injuries?

8. Shall the kind of stretcher be left to the individual whim or the creative genius of the different surgeons throughout the country, or is a uniform stretcher possible and practicable?

The Transactions of the First Aid Conference which will be published later will contain the full discussion on these points. These discussions were most interesting and instructive. In them we may read the point of view of a few chief surgeons of railroads who have introduced first aid measures and instruction and practiced them for a number of years. These surgeons are uniformly in favor of the scheme and are convinced that it is not only humane but economical. Apparently at the present time the few railroads and their chief surgeons who have introduced first aid favor it and propose to continue it.

One chief surgeon who introduced first aid twenty five years ago records its absolute failure. This was due to the fact that the employee wasted the material used it for other purposes, so that when it was really needed the first aid package was not in its place.

This surgeon was probably ahead of his time.

Then there are a number of surgeons who having heard the views expressed at the conference, decided to introduce the scheme on return to their duties. A few surgeons, especially in the States of Illinois and Wisconsin, had recently introduced first aid methods because of State laws compelling them to do so.

The civil surgeons of course, had had little or no experience with first aid. Their discussion was chiefly interesting in that it gave their views on the treatment in the recent state of an accidental wound.

From the military standpoint these transactions

will give a very clear idea of first aid methods in our own Army, Navy and in the Public Health Service. But the surgeons in these services, of course, had had a relatively small experience.

The discussion of the representative of the American National Red Cross Society gives a very graphic account of the splendid effort of this Society to stimulate railroads and other employers of labor to introduce first aid measures and instruction. The Red Cross Society sends one or two cars throughout the country to demonstrate methods and furnish instruction. It has devised many types of first aid packages to meet the requirements of the different types of wounds in civil life.

Then in these transactions one may read the point of view of the railroad officials most interested in accidents—the chief claim agents. They showed great interest and we got the impression that these officials were or could be, convinced of the economic importance of a first aid movement. Apparently, the introduction of proper first aid methods and instruction into railroad mines and manufacturing plants with the medical departments.

The manufacturers of supplies were quite certain that the cost of first aid material could be greatly reduced if the first aid packages and other materials could be standardized and therefore manufactured in large quantities.

The discussions on the first day of this First Aid Conference impressed everyone present with the fact that the conference had come at the proper moment. In the first place the European war had concentrated the attention of surgeons on the problems in wound treatment. The great development of "safety first," the prevention of accidents had paved the way for the second step—the proper treatment of accidents when they cannot be prevented.

The members of this First Aid Conference were also of the opinion that material and methods should be standardized. This is shown in the following resolution which was unanimously passed:

**RESOLUTION PASSED BY THE AMERICAN FIRST
AID CONFERENCE, REQUESTING THE
PRESIDENT OF THE UNITED STATES
TO APPOINT A BOARD OF
STANDARDIZATION**

WHEREAS, There is a great lack of uniformity in first aid methods in first aid packages and in other first aid equipment and in first aid instruction and

WHEREAS, Many of the aims of first aid are defeated thereby and needless suffering and expense incurred

Therefore be it Resolved, That this Conference recommends to the President of the United States that he appoint a "Board on First Aid Standardization" said Board to consist of one officer each from the Medical Corps of the U. S. Army, the Medical Corps of the U. S. Navy, the U. S. Public Health Service, the American National Red Cross, the American Medical Association, the American Surgical Association and the Association of Railway Chief

Surgeons of America, this Board to deliberate carefully on first aid methods, packages, equipment and instruction and to recommend a standard for each to a subsequent session of this Conference to be called by the Permanent Chairman, the creation and maintenance of the said Board to be without expense to the United States.

This conference accomplished the following results: It recommended to the President of the United States to appoint a Board of First Aid Standardization. Most of these appointments have been made, but the announcement of the complete list will have to be made at a later date.

This Board is expected to investigate the entire question and report at a later date to the First Aid Conference. The probabilities are that this report will be ready in the spring at least all those interested in the question hope that something definite can be accomplished within a few months.

In the second place, the conference decided to publish its transactions which will include not only the actual report of the discussions but a summary of the answers to the five questions and a number of other interesting facts in relation to first aid problems.

Then, as stated in the beginning of this article the conference instructed the secretary to make a survey of the opinions and experiences of surgeons throughout the United States and Canada on the more important questions in first aid.

FIRST AID SURVEY

What the secretary will do after the Board of Standardization meets and takes up the burden of its duties rests with the Board, or the Executive Council of the American First Aid Conference. It is the opinion of the secretary that the moment the Board of Standardization convenes in Washington the secretary's duties in the survey end. He will then turn over to the Board all of the evidence that he had collected and he will inform the Board of Standardization about his methods of procedure.

The secretary in making the survey has proceeded somewhat as follows:

Before the meeting of the Conference in Washington the committee sent out to a number of chief surgeons of railroads a page of questions. These questions were also sent to other surgeons, both civil and military. There were not many answers, perhaps about 20 per cent, but some very valuable information was gathered.

In the first place we heard at once from those chief surgeons who had introduced first aid measures into their railroad systems. We were informed of the activities of the National Red Cross along first aid lines and we received the enthusiastic support of military surgeons in our scheme.

One military surgeon who had complete information as to the ideas and hopes of the conference wrote somewhat as follows:

"The success or failure of your conference will depend very largely on the support given by the Public Health Service and Army and Navy Medical Departments.

"The Conference will awaken the profession to a realization that emergency surgery and surgery of accidental wounds is being neglected."

"The conference will be the beginning of active coöperation between military and civil surgeons."

Since the meeting of the conference the secretary has sent the five questions quoted in the beginning of this article to the following:

To about one hundred chief surgeons of railroads. Up to the present time we have received replies from about twenty five. The secretary gets the impression that the majority who have not replied have delayed, because first aid measures have not been introduced in their railroad systems and they have had little or no experience to base their answers on.

These chief surgeons have sent the questions to a number of their associate surgeons varying from twenty five to three hundred. A few of these associate surgeons have already replied.

A number of replies have been received from civil surgeons interested in accident wounds and from surgeons of manufacturers' mines and other employers of labor.

We may not have heard from all who have had actual experience with first aid methods but the secretary is under the impression that a large number of the answers in the future will be more the expression of opinion of what the surgeon himself does when he is called upon to treat an accidental wound than what he has provided to have done in cases of emergency before he is able to see the injured individual.

The secretary was quite confident that the sending of these five questions would by no means meet the requirements of a modern survey. For this reason he concluded that he must have help.

The secretaries of all the national surgical associations and of the American Medical Association and of the Southern Medical Association and the secretaries of all the State Medical Societies have been requested to have a committee of three appointed. This is to be called the First Aid Committee and it is to act independently and also in conference with the secretary of the First Aid Conference and later with the Board of Standardization.

These various committees can be very helpful in making the survey more complete and in getting evidence which may be of the greatest importance but which might have been overlooked in a more superficial method.

WHAT IS WANTED IN THIS SURVEY

In the first place the most helpful evidence will be the experience and opinion of those surgeons connected with railroads, mines and manufactures who through a number of years treated accidental wounds in which there had been employed no first aid measures and then recently have been able to compare this experience with accidental wounds properly treated by first aid measures.

We have reached some of these surgeons and I trust we may find others, and I sincerely hope that these surgeons will go over their evidence again and most critically. As far as the secretary is able to interpret their written and personal communications, these surgeons are of the opinion that the furnishing of first aid material and proper instruction will reduce the cost of accidental wounds from 20 to 50 per cent.

It would be a mistake to have a popular propaganda on first aid and force or influence the employers of labor to introduce it at considerable cost, unless we are quite convinced that we have sufficient evidence that first aid is a necessity and not a luxury.

There can be absolutely no question as to the importance of standardization of first aid material and methods of instruction but have we the evidence as yet which would indicate that first aid methods should be universal throughout the country?

It is my personal opinion and I suppose I have had a better opportunity than many to read the evidence that it would be well worth while for the employers of laborers whether in small or large groups immediately to employ first aid methods and instruction.

The first aid package and other material should be of the simplest and the instruction should even be more meager. We should therefore begin with the simplest and most economical methods and from this develop.

The Surgical Section of the American Medical Association, the American Surgical Association and the Clinical Congress of Surgeons of North America have appointed their committees. The Southern Medical Association and the Southern and Western Surgical Associations will do so immediately. The Conference has apparently received the enthusiastic support of these national surgical associations who with the association of railroad surgeons will be most helpful in making this survey. A number of favorable replies have been received from the secretaries of state medical societies, but as yet no definite committees have been reported to the secretary. A number of state and national medical journals have commented editorially upon the objects of this First Aid Conference.

The secretary of the First Aid Conference is making use of this medium to discuss with the various members of the committees already formed and those to be formed on what is wanted in the first aid survey.

In the first place in discussing it with surgeons, or in reading their answers to the five questions, we must at once differentiate between first aid by the surgeon and first aid by a lay individual.

Even in the discussions at the Conference experienced surgeons missed this point, and in a large number of the replies to the five questions the surgeons are writing how they themselves treat the wounds.

As stated before, there are very few places in

this country where first aid measures are really employed.

On railroads it is the scheme to have railroad surgeons appointed at as short intervals as possible throughout the system and to have as many modern hospitals as possible. In the great majority of railroads the instructions are "Get a doctor as quickly as possible, if you cannot get a doctor, put him on a train and take him to the nearest surgeons or hospital." In a scheme of this kind first aid is simply one of transportation. Get the patient to one of the railroad surgeons and leave the rest to him. Apparently there are a number of railroad surgeons and chief surgeons who favor the development of this plan to the limit.

This scheme as a rule is the one followed in mines, manufactories and in almost all accident surgery. In all cities the patient is simply transported as rapidly as possible to a hospital. Before the days of automobiles and automobile ambulances, police men and firemen were given instruction on first aid methods. I do not know whether they were furnished first aid material. Twenty five years ago it was popular to lecture to policemen on first aid as it is to enthusiastic society girls today.

The secretary would desire the members of the first aid committees of the state medical societies to find out the actual conditions as to first aid in their respective states. It would be most interesting to know the actual condition among the railroads, mines, manufactories, accident insurance companies, large department stores, police and fire departments in the various states.

This investigation by states is a very important one. For example, the Pennsylvania Railroad may not have introduced first aid throughout its entire line, but in one of its branches in one state the system may be in operation, fully developed and most satisfactory.

The state committees may be able to obtain information on account of their closer relationship with the business world and of their personal acquaintanceship with the surgeons interested in accidental work.

I am confident that these state committees can tap new centers and gather valuable information. My day's mail demonstrates the great variety of

channels through which this valuable information comes. An accidental meeting on a railroad train finds the surgeon in charge of a very large manufacturing plant with a fully developed first aid equipment and good records demonstrating its economy and efficiency. In spite of the wide spread propaganda this surgeon had not been reached before.

The first aid committees of the various national surgical associations should confine their efforts chiefly to getting the opinions and experiences of the members of their respective associations. A surgeon with a large experience in accident work may have had no experience with first aid, nevertheless we want his opinion as to the best treatment of a recent wound.

If we decide to instruct the lay man how to treat the wound we are not going to select a treatment radically different from what we as surgeons would employ if we saw the patient first.

There is no doubt in my mind that first aid treatment at the present time must be largely based on the surgeon's experience in wound treatment.

This survey on first aid offers an opportunity for an investigation of whether it is possible and practicable to ascertain in a number of months the experience and opinion of a large group of surgeons on a special chapter in surgery, and whether such an investigation will lead to progress in the standardization of the best methods.

It would seem fair to conclude that the procedures and methods on which the majority agree must be essential while those procedures and methods about which there is considerable disagreement are unessential.

It is quite possible that the results in this survey on first aid, if it can be accomplished in the way it is hoped, may develop a new and efficient way in unifying and standardizing many other surgical therapeutic procedures.

In a second communication there will be a discussion of a critical study of the answers to the five questions.

The writer hopes that the readers of this article will answer the five questions and give him a personal communication of their opinions and experiences not only in first aid, but in the surgical treatment of recent wounds by the surgeon himself.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

By MAJOR G. SEELIG, M.D., St. Louis

HOW often after the wound is sutured and the patient is back in bed the surgeon thinks of some significant technical procedure that he should have executed. Just so in book reviewing a happy thought knocks at the portals of consciousness too late to gain effective entrance. For instance if we had been nimble witted last month¹ in discoursing on English style, we could have clinched our argument by two quotations from the essayists Walter Bagehot and Harris Merton Lyon. Bagehot says very tersely, "The secret of style, is to write like a human being." And Lyon a bit more at length, but no less truly, says "It is only by writing and writing and then writing that a man can begin to find out the golden possibilities of this old pirate language of ours: the opposite adjective the verb that cuts like a whip the sonorous participle, the clever adverbs. And coming to structure the sentence that pulls all sense together, as a driver pulls together four pairs of reins, or the paragraphs that are keystones which keep your page from falling to the ground."

This much is certain—The difficulties in the way of attaining a lucid style in medical composition seem to have no deterrent effect on the output of medical volumes. One is struck by just this thought this month owing to the fact that in spite of the very satisfactory volumes on fractures already published we are presented with a brand new book. And in the face of a very adequate supply of books on cancer we have a new one not even approximately as good as the more mediocre ones already printed. Why? Possibly because medicine is so very chemically a combination of theory and practice. Theory studies the pure instance and practice reckons with variations, therefore since there are innumerable instances and countless variations why not expect an endless number of volumes? Of course such an explanation is at best somewhat academic. A more practical explanation was furnished me by an energetic book publisher who told me in the strictest confidence, that his judgment as to publishing a given volume rested solely on the decision as to whether or not his score or more of salesmen could sell it. Let us not lose our equanimity but let us also not forget that it was exactly this same sort of technique that brought the lightning rod into obloquy and disrepute.

THE little volume on *Cancer*² by Taylor presents itself without so much as a bow of acknowledgment or recognition to its numerous host of predecessors. A glance at the book shelves discloses that within very recent times there have appeared treatises on cancer by Moulhin, Bell, Williams and Bambridge in addition to which we have the more academic and encyclopaedic volumes by Bland Sutton, Ribbert, Borst, Behla and Wolff. Surely there ought to be some very concretely demonstrable cause calling for a new book on cancer, and whatever else Dr. Taylor may have accomplished he has not made clear this need. If his plea be that the laity cannot be over educated along lines of cancer incidence and prevention, then we can only answer that he has not so framed and compressed his book as to make it primarily meat for the masses. If on the other hand, his plea be that his colleagues cannot be told too much about the details of cancer, then we feel that he is, to say the least not disposed to flatter the fulness of the intelligence of his colleagues. The method of handling carcinoma of the breast is more than primitive and properly belongs to the kindergarten course of surgery. The chapter on carcinoma of the uterus is very full and adequate, and as contrasted with the preceding chapter on carcinoma of the breast seems to furnish forcible evidence against the propriety of even a well trained gynecologist expatiating on cancer at large. Under the head of cancer of the tongue, two symptoms are described, pain and stimulation. Such paucity carries its own condemnation without the need of even so much as a word from the reviewer.

Granting that the little volume makes no pretense to originality, explicitly stating as it does in the preface a desire only to put well known facts together and "place them within easy reach of the profession," we nevertheless feel the necessity of calling attention to the fact that many of us have surfeited of such a diet and that we demand some additional touch of personality, some variation in body of content or some particularly worthy or commendable attribute that will justify the new presentation of an admittedly old body of facts. In a single word the book may be characterized as inadequate. It lacks that one essential of all good volumes—scope. The general plan is good, but

¹ *CANCER—ITS CAUSE AND PREVENTION*. By Howard Canning Taylor, M.D. Philadelphia and New York: Lea and Febiger 1915.

for that matter, the water cracker is also good, hygienically perfect, but one needs something to take with it

THIS, the eighth edition of Scudder's work on fractures,¹ requires mere mention, for the reasons that the book has already made a place for itself, and that we have, in the past, commented most favorably upon it. The revision was called for by the vast amount of work recently done along lines of operative treatment for fractures, and the use of autogenous bone grafts for delayed union and non union. The subject of bone grafts is handled in an intelligent and satisfying fashion by the author, who also discusses the operative treatment of various fractures in a most gratifying manner. Probably the most significant paragraph in the book, is the one which closes the preface, namely, "I believe definite indications must be present in any case before operative treatment is employed. Operative treatment is not to be undertaken lightly."

It would be more or less useless to enter into a detailed discussion of a book so well known, and yet its essential excellence prompts anew a word of commendation for the admirably practical tone of the volume. We miss the scholarly academic note so predominant in Stimson's large treatise, but in many ways the miss is a happy one. For Scudder's chapters stand as the very apotheosis of 'infinite eiches in a little room.'

CROWDING closely on the heels of Scudder's volume, comes an entirely new book on *Fractures and Dislocations* by Preston.² Right over there on the second shelf from the top are a couple of good fat tomes in German and three uncommonly good ones in English by Scudder, Stimson and Cotton. How natural it is therefore to sigh in doleful anticipation. This book by Preston however, is built to meet the cold reception of a sighing reviewer and still make a favorable impress. The reason for this is fourfold. In the first place, the author excels in his clear descriptions of the altered configurations consequent upon fractures and dislocations, thus emphasizing that most important art—inspection. Secondly, he furnishes a lucid, terse, and clear discussion of the anatomical principles involved in the various types of injury. Thirdly, he is the first author to my knowledge who groups fractures with dislocations after the rational

fashion of regional surgery, and fourthly he furnishes a set of illustrations which, although modestly crude, nevertheless illustrate very concretely.

Dr. Preston succeeds admirably in doing just what he sets out to do in his preface, namely, "to offer a working knowledge of the subject." He has the happy faculty of centering attention on broad principles without eliding the significance of seemingly unimportant details. Just exactly what we mean by this statement may be best learned by reading his description of the application of the Sayre dressing for fractured clavicle.

Most praiseworthy in this day of indiscriminate operative attacks on fractures is Preston's plan of carefully outlining operative methods, indications, contra indications and dangers. This he does under the separate head of "Operative Treatment," after first outlining the usual non operative procedures, and he consistently follows this plan for every fracture described.

Unfortunately, the book is not completely in balance. This fault is not glaring, is easily corrected and is due both to some significant omissions as well as to an evident straining to cover too much ground. For example, there are twelve pages devoted to simple scalp wounds and fourteen pages devoted to a complex differentiation of the various types of coma, due to numerous drugs and diseases. How much better it would have been to concentrate on the basic phenomena of compression, after the fashion of Trotter in Choyce's *System* and to detail more carefully the rationale of operative treatment in skull fractures. It certainly must be confusing to the student to read that operative treatment for skull fractures is called for "to relieve depression, meningeal hemorrhage for the removal of foreign bodies, for the correction of secondary complications such as cortical irritation from old scars and for the treatment of tumors, abscess or softening." There is on the whole, a definite uncertainty of pace in the pages devoted to skull and spine that contrasts rather markedly with the corresponding chapters in Scudder.

In St. Louis, the home of Hodgen, where we see so many really incomparable results following the use of the Hodgen splint in thigh fractures, we would welcome a more adequate description of this appliance. We cannot state the case any stronger than this, for we realize that personal preference as to method of treatment is a more prominent factor in the handling of fractures than it is in any other branch of surgery. It is a pity, however, that the only adequate description of the Hodgen splint is the one written by the late Henry Mudd in the now old *System of Surgery* by Park.

¹ THE TREATMENT OF FRACTURES with Notes upon a Few Common Dislocations. By Charles Locke Scudder, M.D. Fifth edition revised. Philadelphia and London: W. B. Saunders Company 1925.

² FRACTURES AND DISLOCATIONS: DIAGNOSIS AND TREATMENT. By Miller E. Preston, A.B., M.D. With a Chapter on Radiology. By H. C. Storer, M.D. St. Louis: C. V. Mosby Company 1925.

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THE PHYSIOLOGICAL TREATMENT OF BULLET AND SHELL WOUNDS OF THE PERIPHERAL NERVE-TRUNKS

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THESE remarks are based on the study of cases observed while in charge of Hospital B, American Ambulance, Juilly-France. Hospital B, established and maintained by Mrs. Harry Payne Whitney of New York, started with an equipment of one hundred and fifty beds which has now been increased to two hundred and thirty-five. The hospital is situated at Juilly-Seine et Marne, thirty-five miles behind the firing line and receives its wounded from the sixth French army.

The contemporary literature of military surgery is rich in the operative and post-operative treatment of gunshot wounds of the peripheral nerves while the all-important preliminary treatment has received scant attention.

Primary suture of a divided nerve is the ideal treatment but with a few exceptions this method is absolutely contra-indicated under the conditions existing in war time. The necessity of such an operation presupposes an anatomical division of the nerve. There is no sure method of immediately differentiating between anatomical and physiological blocking of nerve impulses. The symptoms are the same. This failure to recognize the impossibility of distinguishing between a division, a contusion, and a concussion of a nerve has led to many unnecessary and harmful operations. On the other hand

the element of time coupled with treatment based on physiological principles has cleared up many misleading symptoms and considerably reduced the number of cases requiring a secondary suture. Even if it were possible to make such a diagnosis operation is absolutely contra-indicated as all projectile wounds are potentially infected, and to operate in the face of infection is to court disaster (Fig. 1). For these reasons it was our practice to treat all peripheral nerve lesions on an expectant plan, postponing nerve suture until the wounds were healed.

Many brilliant technical operations have given disappointing functional results. The operator besides contending with the uncertainties of nerve suture has had to correct accompanying deformities and to struggle against muscular degeneration. Such complications are in a large measure preventable and it is imperative to see that they do not occur. From the first, a suitable apparatus should be applied to relax the paralyzed muscles and protect them from strain at the same time measures being instituted to preserve the nutrition of the muscles and maintain their excitability to electrical stimulation.

Immediately on the admission of a patient the following procedures were carried out:

1. A careful inspection of the soldier's clothes to determine the absence or presence of clothing in the wounds.



Fig. 1 Destruction of the elbow joint by a bullet wound. Gas gangrene. Paralysis of median and musculospiral. This shows the impossibility of primary suture. Condition of wound two and a half months after reception.

2 Examination and dressing of the wound with a careful search for symptoms of nerve injury.

3 X ray examination of every patient.

4 On the data derived from these procedures a course of treatment suitable to the individual case was instituted.

One must keep constantly in mind the extreme gravity of an injury to an important peripheral nerve remembering that the unrelieved pressure of a bone splinter, an inflammatory exudate, or a jagged shell fragment may lead to irreparable damage. The prompt recognition and correct treatment of such conditions are imperative.

Shell fragments shrapnel, etc. were removed by the Sutton localizing technique. This provided a simple, safe, and accurate means of removal and had the added advantage that it could be carried out under local anesthesia. As a large percentage of the wounds were complicated by compound comminuted fractures it was necessary to provide for suitable fixation. In applying the splint two factors had to be considered:

(1) The immobilization of the bone. (2) The relaxation of the paralyzed muscles and their protection from the pull of their opponents. For example, in a fracture of the middle third of the humerus with injury to the musculospiral resulting in a drop wrist some form of "cock up" wrist splint had to be applied in addition to the splint for the humerus.

In the first two hundred and twenty five cases there were thirty-three nerve lesions. Of these, twenty-nine were injuries to the peripheral nerves. The musculospiral was involved eight times, the ulnar six times, the median four, the external popliteal twice, the circumflex once, the musculocutaneous of the leg once, the sciatic once, the brachial plexus with sensory disturbances in the ulnar once. Besides these lesions of single nerves the following complex lesions were encountered: median and ulnar twice, musculospiral and median once, musculospiral and circumflex once. The circumflex in the complex case of circumflex and musculospiral was an indirect lesion, the wound of the musculospiral being two and one-half inches distant from the circumflex. Seven of the musculospiral lesions were complicated by compound fracture of the humerus (Figs. 2, 3, and 4), one by the lodgment of a shell fragment (Fig. 5). All were below the branch to the triceps. In two of the cases where the fractures were near the elbow the pressure symptoms on the nerve were greatly relieved by supinating the arm and placing the elbow in acute flexion (Figs. 3 and 4).

One case of supposed division was explored and the nerve found to be only contused. No operative work was attempted and under the routine treatment the patient made a rapid recovery.

One of the ulnar cases was the result of a stab wound received shortly before entrance to the hospital. Primary suture was performed with a good result.

Musculospiral injuries. The basic principle underlying the physiological treatment of this lesion is the use of an adjustable splint to hyperextend the hand and abduct the thumb the arm being supinated. The hyperextension counteracts the continuous effect



Fig 2

Fig 2 Shows character of fracture accompanying the injury of musculo-spiral nerve



Fig 3

Fig 3 Bullet wound Compound comminuted fracture of humerus with paralysis of musculo-spiral nerve

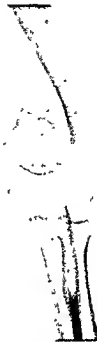


Fig 4

Acute flexion of the elbow joint relieved the pressure on the nerve

Fig 4 Penetrating wound of arm, made by a trenching tool Injury to musculo-spiral and ulna Improving

of gravity relaxes the paralyzed extensors and stretches the flexors thus restoring the muscular balances and preventing the occurrence of a contracted drop wrist. The wrist is kept in this position of hyperextension until voluntary power is restored by nature alone or nature aided by the surgeon. Physiological experimentation has taught us that the result of unrelieved overstretched, muscular tissue is fatty degeneration and a consequent loss of contractility. Clinical instances of such deformities are all too frequent despite the teachings of Thomas Jones Tubby, and Tuffier. Strange as it may seem scarcely a textbook on neurology emphasizes the value of mechanical support to prevent contracture.

To support the wrist we used a flexible wire splint (Figs 6 and 7). It was light and any necessary adjustment in the angle of hyperextension could be readily made. The splint, extending from the finger tips to the



Fig 5 Musculo-spiral injury with drop wrist caused by a small shell fragment

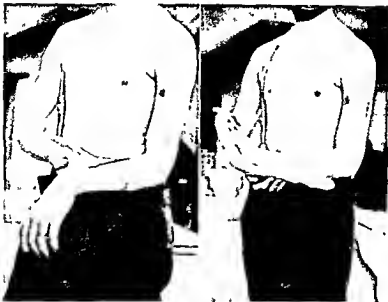


Fig 6 (at left) Perforating bullet wound of the soft parts at the level of the deltoid. Note drop wrists.

Fig 7 Same case as Fig 6 treated by the hyperextension method. Shows a temporary splint used while the Tuffier splint is being made. There is an error in this picture as the splint is too long and there should be only one strap, that at the wrist.



Fig 8 The Tuffier splint, palmar aspect. Note hyperextension of the wrist with abduction of the thumb. Fixation by faced wrist band.

lower third of the forearm, was secured at the tendinous portion of the wrist, care being taken to avoid pressure on the paralyzed muscles. The hand was kept in this position as long as there was any tension. The test for improvement was the ability of the patient

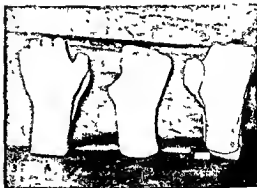


Fig 9 Tuffier splint for drop wrist. A, Plaster cast of hand in the hyperextended position. B, Moulded aluminum splint, the surface that is applied to the palm. C, Position on cast showing hyperextension.



Fig. 10 Showing the improvement after using the Tuffier splint

to lift his fingers from the splint. As the patient improved, the splint was shortened to the bases of the first phalanges. A better and more comfortable splint was called to our attention by Professor Tuffier consulting surgeon to the French army. The object of the Tuffier splint (Figs 8, 9, and 10) is not to immobilize the hand, but to render the hand useful. It is essentially an aluminum plate exactly molded to the hand, lined with chamois and kept in place by a lacing over the back of the wrist. The sense of support and comfort derived from this splint was so gratifying that we adopted it as our standard.

The nutrition of the muscles was maintained by the use of warm starch baths, systematic massage, muscle kneading, and exercises applied by trained assistants. The value of massage and exercise is emphasized for there is a great tendency to sit back and say "let electricity do it," but here we are not dealing with a simple nerve but with a nerve lesion complicated by comminuted bone, torn muscles, inflammatory exudate, etc., the whole tending to form obstinate adhesions. The galvanic current being a good stimulant to nutrition is of more value than the faradic, but compared with the other measures electricity plays but a minor part.

Ulnar injuries. The resulting muscular strain from a paralysis or a weakness of the flexor carpi ulnaris, half the profundus, and the interossei is overcome by spreading the fingers apart, flexing the first, extending the second and third phalanges, and adducting the thumb. This position can be readily maintained by an accurately molded, aluminum splint.

Median injuries. The resulting muscular strain from a weakness or paralysis of the flexor carpi, radialis, flexor sublimus, half the flexor profundus, and the pronators is overcome by strong flexion of the hand and fingers, abduction and flexion of the thumb, and slight rotation of the arm (Fig. 11).

Circumflex injuries. The paralysis of the deltoid is combated by abducting the arm.

Injury to the external popliteal and musculocutaneous. The foot is placed in a position of strong dorsal flexion and eversion (Figs 12 and 13).

Complex nerve injuries. In complex nerve injuries each combination has to be worked out on physiological principles. For example, in lesions involving the musculospiral and median, a mid position has to be assumed but as gravity also plays a considerable part a slight hyperextension of the wrist with strong flexion of the fingers is admissible.

infected I usually wait six to eight weeks after the wound is completely healed. The reasons for early operation are the following:

The earlier the operation is performed the better are the anatomical relations maintained, the scar tissue is present in smaller amount, it is soft and easily removed, the capillary oozing is diminished thus preventing the tendency to hematoma formation and the development of more scar tissue.

If the nerve is compressed by callus or scar tissue the longer the operation is delayed the more injury is done to the nerve.

The longer foreign bodies are present the more scar tissue develops and the greater is the nerve destruction.

The longer the operation is delayed the firmer are the muscular contractions and the greater the deformity in the joint.

The longer the muscle is paralyzed the stronger is the contraction of the healthy muscles and the more marked is the fixation of the joint in the pathological position.

These contractions due to nerve lesions can be prevented by early operations.

Many trophic changes in the skin, muscles, bones, and joints can be prevented by early operation.

Severe pain which cannot be controlled by other means is always an indication for early operation.

In those cases in which it is impossible to perform an early operation the paralyzed muscles must receive mechanical support, treatment and be kept in spints ways to maintain their proper position.

A great deal of time and expense is saved by early operation.

The only argument against early operation besides infection is that a positive diagnosis cannot be made and there is a question as to whether the function may not return without operation. From the many different reasons given above I cannot understand why the neurologist insists upon delaying the operation for five to eight months.

PATHOLOGICAL CHANGES FOUND

When the nerve is completely torn the gap is filled with a dense homogeneous mass of scar-tissue, the ends are retracted, knobby or

spindle form, and are often very difficult to recognize. Contracting bands may be seen about the irregular fragmental ends. These bands often explain the cause of the severe pain. However, I have seen cases of severe pain in which these bands were wanting.

When the nerve is only partially lacerated the torn fibrils are retracted, embedded in a spindle form mass of scar tissue which may assume the form of the nerve or may be flat or form a definite constriction at the point of injury. In some cases the scar extends on the sides of the nerve, binding it to the surrounding tissue and giving it a flattened appearance.

The amount of scar tissue present depends upon the type of injury and the severity of infection that has taken place, the greater the destruction of the muscle tissue in the compound infected fractures, the more scar-tissue results.

Neuroma formation has occurred in all of the fragmental nerve ends.

I have found small metallic splinters, bone and muscle fragments in the injured nerves and incorporated in the scar tissue about the lesions.

Frequently the fragmental nerve ends are found embedded in dense callus and between bone fragments. In one case of spiral fracture of the humerus in the distal 1/3 of the radius-spiral groove three months after the injury the central and the peripheral ends of the musculospiral nerve were found embedded in dense bone, the respective ends being separated six centimeters. In this case it is possible that in reduction of the fracture the ends of the nerve were caught between the ends of the bone and embedded in the bony callus.

Small hemorrhage or exudate under the perineurium may cause a temporary inhibition of function.

I have seen two cases of multiple injury to the musculospiral nerves.

TECHNIQUE OF OPERATION

The important points in technique to secure perfect function are the accurate coap-
tion of the normal nerve ends in their physiological anatomical relation with an aseptic

wound healing without the formation of a hematoma; early passive and active motion, and massage, with the application of heat and electricity

All operations were performed without the application of the Esmarch tourniquet. I have found that it is more difficult and time-consuming to control the capillary oozing when the Esmarch constriction is used. The wound must be left in a dry condition before closure. It is not advisable to apply a compression bandage over the wound to control the hemorrhage, because the pressure over the nerve may injure the line of suture. The development of a hematoma is to be prevented. If the oozing cannot be controlled, a cigarette drain should be inserted for twenty-four hours. Hemorrhage resulting from the cross section of one of the large nerves should be controlled by digital compression of the nerve. If this does not suffice, a fine point hemostat should be carefully applied to the vessel and then given a few turns. Ligation is seldom necessary.

Through a long incision over the course of the nerve, with careful control of the bleeding, the central end of the healthy nerve is located, and, by sharp dissection, prepared toward the point of the injury. All scar tissue is carefully removed and the nerve lifted from its bed and palpated. If the nerve has an abnormal appearance, I resort to Hofmeister's (3) diagnostic injection of a one half per cent solution of novocaine to which one drop of suprarenin to ten centimeters has been added. The injection is made beneath the perineurium. It loosens the perineurium, and separates any septa that may have formed so that the fibrils are loosened from any constrictions that may exist. Sometimes constrictions are seen that can be split and the nerve assumes a uniform cylindrical form. If upon palpation abnormal resistance is felt a diagnostic incision can be made into the suspected portion and the fibrils exposed for macroscopic examination, after which the perineurium is carefully sutured, and the nerve is placed in a new muscle bed free from scar tissue.

If the nerve ends are separated and embedded in a mass of scar tissue which necessitates a resection of the nerve, I do not dis-

turb the normal anatomical relation of the nerve until I have placed a fine silk guide-suture in the mid-line of the perineurium in the central and the peripheral ends some distance above and below the lesion. This guide-suture helps to approximate the nerve in its normal anatomical position. If we are not careful the motor fibers may be approximated to the sensory fibrils, and in this way delay the restoration of function. Care must be taken not to injure the intact muscular branches, for if we do function may return in the nerve that has been sutured, but another group of muscles may lose their function. I have seen a number of patients that have been made worse by the operation.

If electrical examination shows that a portion of the nerve is still intact careful dissection must be made so as not to injure the intact fibrils. The scar-tissue is excised, leaving the healthy portion of the nerve *in situ* and the resected ends approximated with fine perineural catgut sutures.

How much of the nerve should be resected? I usually make the first section with a thin, sharp knife (a Gillette razor blade held with forceps does very well) just a little beyond the junction of the scar with the healthy nerve. Usually some areas of scar-tissue are still to be seen in the healthy end. Millimeter sections are made until the nerve presents a normal histological appearance. A histological examination of a piece that was thought to be normal still showed the presence of scar-tissue, but in this case a good functional result was obtained. This shows that regeneration takes place if a small portion of scar-tissue remains.

The approximation of the ends so that they can be sutured without tension is often difficult. It can usually be brought about by manual manipulation of the nerve, that is, gradually stretching it by flexion of the joints and by luxation of the nerve from its normal course. In case of pseudo arthrosis in the region of the injury, resection of the bone allows the ends of the nerves to be readily approximated. In a case of resection of the musculospiral nerve where a gap of 10 centimeters existed, Borchard (4) implanted the central and the peripheral ends, into the musculocutaneous

In nine months the triceps and the supinator regained their function, the extensors were still paralytic and the abductor pollicis had slight functions. Hofmeister (3), independent of the work of Borchard, has done during the past year a large number of operations of nerve implantation. In some cases he has performed double and triple implantations. I had to resort to the nerve graft only once, in which case the central end of the ulnar was grafted into the median nerve in healthy tissue above the injury and the peripheral into the same nerve some distance below the injury. The healthy nerve was not injured through this procedure.

The nerves are sutured with fine catgut, grasping only the perineurium and applying six to ten sutures. In some cases where the tension is too great a stronger suture is applied through the substance of the nerve. I always try to avoid suturing through the substance of the nerve.

The question of how to protect the nerve after the suture has not been definitely decided. Fascia, fat, muscle, veins, and artificial organic tubes have been used for this purpose. Hofmeister (3) reports an interesting case. He made a circular anastomosis of the musculospiral nerve and covered the sutured line with a portion of a vein taken from the patient. There was no improvement after five months. On operating again he found the nerve in good anatomical relation. The place of suture was hardly recognizable, but the nerve had changed into a hard, round mass of fibrous tissue. On section of the nerve no fibrils were to be seen.

In my cases I have prepared a new bed, free from scar-tissue, from the surrounding muscles. It was often necessary to use a pedunculated muscular flap. In operating on the brachial plexus where sufficient muscle-tissue could not be had a fascial flap was used. The tissues which came in contact with the nerve were infiltrated with fibrolysin. It is questionable if fibrolysin will help to prevent

the formation of new scar-tissue. Professor Tuhy has had splendid results in preventing the recurrence of Dupuytren contraction in cases operated on.

The after-treatment consists in the removal of the splints that have been applied to keep the joint in extreme flexed condition, on the fourteenth to the eighteenth day, early passive and active motion, massage, and the application of heat and electricity.

PROGNOSIS

The longer the nerve course is broken, the slower regeneration takes place after suture.

The farther peripheral the nerve is injured the sooner function returns after suture.

The larger the nerve and the more centrally located the injury, the slower the return of the function.

I have seen function return in a sutured ulnar nerve just above the condyles in ten weeks. As a rule no marked changes take place until the lapse of three to six months.

The neurologist to the Dollinger clinic showed me a case of complete laceration of the musculospiral nerve with a typical wrist drop and complete reaction to degeneration, which had been operated upon three weeks previously, resection of the nerve with suture being performed. The patient stated that he could extend his fingers two weeks after the operation, whereas before the operation he said that he could not move his wrist in the extended position. The neurologist verified his statement. He showed me the history of the X-ray examination before the operation and demonstrated the change that had taken place since the operation. He says that it is the first case that he has seen recover so promptly after the operation and is at a loss how to explain the sudden change.

REFERENCE

1. Berl Klin, 1915, No 2
2. Berl Klin, 1915, No 48
3. Beitr klin Chir xcvi No 3
4. Deutsch Ztschr f Chir 1907 lxxxvii

MEDICAL ASPECTS OF THE WAR¹

By ROGER I. LEE, M.D., Boston

THE observations upon which my remarks are based were made during the past summer. The second Harvard unit, of which I was a member, had charge of a British Base Hospital of 1040 beds at Camiers, Northern France. Our patients were with rare exceptions British soldiers. We had no commissioned officers for patients. Our hospital was one of a group of similar base hospitals in the vicinity. Consequently, it has been possible to confirm my own personal data with similar observations made by other men in these other hospitals. While I saw something of the London Hospitals, I saw none of the French Hospitals. My remarks must therefore be limited to the conditions observed among the British Expeditionary Force in France. I purposely omit from discussion the ordinary cases of illness which are common both in civil and military practice. Our hospital which was a general hospital had a goodly proportion of patients whose illnesses could in no way be attributed to the war.

Hospital service in the war zone always implies the treatment of the wounded. Yet the experience in previous wars has been quite otherwise. In nearly all wars the so called medical cases have largely outnumbered the surgical cases. This, of course, has been largely due to the prevalence of typhoid fever and the various dysenteries. In our Spanish American War the records show that 25 per cent of all soldiers in encampments had typhoid fever. Consequently the very large majority of army surgeons confined their work exclusively to the care of typhoid fever. In the present war, due to many causes but more particularly to the advance in sanitary science, the records seem to show more surgical cases than medical cases. In the hospital assigned to the second Harvard unit the 1040 beds were roughly divided into two divisions, a medical and a surgical division. The medical cases comprised one-third to one-half of all the cases. During my stay there

I did not see a single certain case of typhoid fever. There was one doubtful case. From the reports of other hospitals it was evident that typhoid fever was a rarity, which speaks well for the sanitary arrangements of the British Army. In one group of 55,000 troops, 58 had typhoid fever with 2 deaths. In our Spanish-American War a similar group would have shown probably over 10,000 cases. Furthermore, the fact that typhoid fever did exist to a considerable extent in the civil population showed that typhoid fever was an ever constant menace.

Perhaps as important a factor in the reduction of typhoid fever as sanitary inspection was the preventive inoculations. The British fairly generally use two inoculations in place of the three inoculations which have shown such remarkable results in our army service. On account of the tremendous pressure in raising the large voluntary army the anti-typhoid inoculations have not been systematically administered in every instance. Some men received no inoculations and others only one and still others two at improper intervals. Most of the cases of typhoid seem to occur in those who had not been inoculated or in those who had had only one injection.

Para typhoid fever occurred more commonly than typhoid fever but was still unusual. The fact of its occurrence demonstrates that the sanitary measures are not yet perfect, and more important still that the typhoid inoculations play a large rôle in keeping down the typhoid fever. Under the conditions the diagnosis of para typhoid fever was difficult. It is possible that a considerable number of unexplained fevers with negative blood cultures when seen at the base hospital, and negative serum reactions to the two common types, could have been demonstrated to show some form of the para-typhoid group by complete bacteriological examinations of the stools.

Diarrheas were surprisingly infrequent,

¹ Read before the Clinical Congress of Surgeons of North America, Boston, October 25-29, 1915.

perhaps not more frequent than in a similar group in civil life. There was one case of bacillary dysentery which was demonstrated by the mobile laboratory near the front.

While most infectious diseases did not come to our hospital, I saw elsewhere the usual run of measles, mumps, scarlet fever, and venereal diseases that are endemic in any community life. Scabies which had been rampant earlier in the war was still frequent.

There was one very surprising aspect with regard to infections of the respiratory tract. During my stay through the summer months the ordinary infections of the upper air passages were distinctly rare. Tonsillitis was not seen. Acute bronchitis existed nearly always as an exacerbation of a chronic bronchitis. Pneumonia occurred both in the form of lobar and bronchopneumonia, giving the usual classical signs but in our experience without sputum. The absence of sputum prevented our determining the infecting organism. The course of the pneumonias was not typical of the frank infections with the pneumococcus with sudden onset and defervescence by crisis.

There were many cases of so called "rheumatism." I use the term "rheumatism" advisedly because these cases comprised a very unusual group. We had a few cases of typical arthritis but always in patients who had had previous rheumatic fever. The vast bulk of the rheumatic group was essentially similar. The onset was more or less abrupt with fever which varied in intensity. Shortly after the onset there developed considerable pain in the muscles, chiefly in the legs and back. This pain and muscular tenderness persisted after the fever subsided. There was no history of a preliminary sore throat or coryza or of any focal infection to suggest the point of entrance. In a small group carefully analyzed by Dr F W Snow no common etiological factor such as exposure, frost bite, etc., could be demonstrated. Nevertheless these cases were definitely infectious. The course of this condition was a few weeks. We felt that the salicylates cut short the temperature but had no effect upon the pain. None of the various remedial measures seemed to control the pain

which was often so severe as to suggest a neuritis. However, there was never tenderness over nerve-trunks or modified reflexes. Cardiac complications were noted in no case. The condition was well recognized and went under the popular name of "trench rheumatism." It seemed to be a true infectious myositis of a type not seen in civil practice. How much exposure and posture had to do with the localizing the symptoms in the legs and back was uncertain.

Another new clinical entity of which we had a considerable number of cases in common with other hospitals, and of which I saw some cases from the Dardanelles in the London hospitals, was the so-called "trench nephritis." This condition was of all grades and severity. A typical case might be described as follows. The onset was sudden and often could be dated to a particular hour in the day. Fever, general malaise, bloody urine, and oedema, all appeared simultaneously. The duration of the fever varied from a few days to a few weeks. With the subsidence of the fever the blood and oedema also usually subsided. There seemed to be a period in which the patient felt perfectly well but passed urine with 1 to 2 per cent of albumin, but with no cellular elements. The terminal stage was represented by small traces of albumin but considerable amounts of pus in the urine. Bacteriological investigations were negative. Some of the patients had coma. Our experience in common with that of the other hospitals showed that the blood-pressure never was high, our highest recorded systolic blood-pressure among our cases was 170 in a comatose individual. Recovery was the rule and occurred without exception in our cases. The condition seemed unquestionably an infection, a true acute nephritis of unusual type in that it was apparently very severe at first but remarkably rapid in its convalescence.

Another group of cases which included nearly half of the medical cases was composed of the functional nervous disturbances. A certain proportion of them was the functional disturbances seen in civil life. For example there were the functional gastric disturbances which, however, seemed fairly constantly

associated with bad teeth. Cardiac neurosis is common enough in civil life and is seen in many forms. In our cases of cardiac neurosis, however, we found practically only one type. This occurred at all ages, although perhaps more common in the men over thirty. The type of occupation previous to entrance to the army made no difference. The symptoms varied in severity but were essentially always the same. The patient complained of fairly constant tachycardia with palpitation, dyspnoea, and cardiac pain on exertion, never oedema. On examination the heart was of normal size, rarely slightly enlarged, the sounds were unusually sharp and slapping, especially the first sound at the apex. There was no accentuation of the pulmonic second. The blood-pressure was normal. The pulse rate varied between 80 and 140. There was no particular change after exercise. In these cases there were increased reflexes and the evidences of vasomotor instability such as perspiration, congestion of the hands, etc. No other evidence of thyrotoxicosis was apparent. While some of these cases improved somewhat, most of them under observation of several weeks remained essentially the same. In some instances rest in bed, in others cardiac tonics such as digitalis were tried but without benefit. While the ultimate prognosis was probably good the immediate prognosis for weeks and apparently for months seemed bad. The majority of these men were incapacitated for sustained hard labor.

Under the general heading of "shock," a very poor term which we were compelled to use for want of a better, was classified a large variety of functional disturbances. In these cases, as a rule there was a history of some definite etiological factor, for example, some of these men had been gassed but did not suffer particularly from the affect of the gas itself. A more common story was that a large high explosive shell had exploded within a few yards and very likely killed or maimed some of the patient's comrades. The patient himself was not even scratched. Another common etiological factor of this so-called "shock" was being buried. As a rule the

soldiers were not much affected by being buried by the dirt thrown up by an explosive shell provided they did not lose consciousness or have to be dug out. If they lost consciousness and had to be dug out the usual result was some form of shock. A certain number of cases of shock, chiefly in the younger men, seemed to be due to the summation of repeated small insults to the nervous system such as a prolonged artillery fire or the prolonged wear and tear of life in the trenches rather than to any single incident.

This so called shock manifested itself in various ways. Some of the patients were completely aphonic. These usually recovered their speech spontaneously in one to three days without particular treatment. Others developed very pronounced stammering. Those cases seemed more obstinate and while they improved considerably, nevertheless they were not completely recovered by the time that they were physically able to take up their work. Generalized tremors were fairly common. Some interesting cases of unilateral tremor with diminished reflexes on the affected side were seen. Other cases could not describe their symptoms except by saying that they felt themselves "nervously done up" and that they were incapable of concentrated or sustained effort. Others described curious waves of terror that swept over them. In these latter groups of cases terrifying dreams and nightmares were common. One unusually courageous corporal had been shocked by a shell. He felt perfectly well and could stand the noise of all other explosives but the peculiar noise of a shell put him in a panic. It was remarkable to note that it affected the seasoned veterans of previous wars just as much as the recent volunteers. It was also interesting that in general the soldiers bore their wounds not only with fortitude but with equanimity. Apparently their nervous systems were adjusted to wounds by previous contemplation of the probability of being wounded. Yet the soldier without a scratch the same distance from the exploding shell as his wounded comrade suffered from shock, while the wounded soldier had his wound but no shock.

PECULIAR INFLAMMATIONS OF THE ILIAC FOSSA, FOLLOWING SIMPLE EPIDIDYMITIS

REMARKS ON THE ANATOMY OF THE LYMPHATICS

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THE object of the present paper is to discuss the origin of some obscure inflammations in the iliac fossa to which surgeons and urologists have paid but little attention so far as I can ascertain.

Here are the histories of two of my cases:

CASE 1 The patient, 33 years old, has always been in excellent health, he had gonorrhea three years previous. On November 5, 1913, while lifting a heavy barrel, he felt a sharp pain in the left groin. I saw him the next day and found an indistinct soft swelling along the left spermatic cord, which I diagnosed as a hematoma of the cord, it disappeared in about two weeks, a point interesting to note in view of the predisposition often given to tuberculosis by a trauma. The left testicle and epididymis were normal at that time.

On December 31 (i.e. seven weeks later) the patient came to see me again, complaining of a slight pain in his left testicle. On examination I found a hard and tender nodule, the size of a small hazelnut, in the globus minor of the left epididymis. In the middle of January that nodule attained the size of a large hazelnut and was quite painful. At the same time a rounded swelling the size of small hen's egg was noticed in the left iliac fossa, it was oblong in shape, parallel to the external iliac artery and just at the inner side of that vessel, the lower pole of the ovoid just reached Poupart's ligament and I thought that some deep fluctuation was present.

On January 20, a consultation was held with another surgeon who had the blood examined, found a positive Wassermann and persuaded the patient to accept a treatment with salvarsan. At the same time the swelling in the iliac fossa was aspirated at a point near the external iliac artery above Poupart's ligament, and about 10 ccm of pus was withdrawn and saved for injection into a guinea pig. The urine was normal, the prostate was enlarged and tender and contained two or three indurations in the left lobe of the gland.

On February 10 there was no change in the condition of the epididymis, the lowest part of the vas deferens showed several typical spindle shaped swellings, but the rest of the duct was not altered. There was a large abscess in the left iliac fossa, about 250 ccm of thick pus was withdrawn by aspiration and about 50 cc of iodoform glycenn injected into the cavity.

On March 8 the pathologist who had examined the guinea pig reported the case as one of tubercu-

losis, and I persuaded the patient to submit to the operation of epididymectomy, but at the same time I strongly opposed any exploratory incision in the iliac fossa, as had been suggested to him by another surgeon.

On March 20 I performed epididymectomy. The wound healed by first intention and the patient left the hospital on the ninth day. The abscess in the iliac fossa was aspirated at the same time and again a large quantity of pus was withdrawn. The abscess filled again, but more slowly, and when aspirated for the last time on April 30, only 20 ccm of pus were obtained. A swelling persisted for some time high in the iliac fossa, just inside of the external iliac artery, and then disappeared completely. Since that time he has been in excellent health, there is hardly any atrophy of the testicle, the urine is normal, the prostate shows two small fibrous nodules on the left side but is no more enlarged. Fifteen months have elapsed since the operation and so far nothing suspicious has developed in the right testicle.

This rare coincidence of a simple tuberculous epididymitis, with a large tuberculous abscess of the iliac fossa in the same side, will be discussed further on.

CASE 2 A young man 27 years old came to see me on April 6, 1915, with an acute gonorrheal epididymitis of enormous size, but the epididymis was nowhere adherent to the scrotum, and the vas deferens was only moderately swollen. The patient was put to bed and treated with compresses. A week later, on April 14, the epididymis was still quite large but not so tender as before. The patient complained of a pain in the left iliac fossa but I could find nothing there. On April 22 I saw him again. The epididymis was still very large, high in the iliac fossa, exactly on the external iliac artery, there was a swelling the size of a small hen's egg, with irregular surface and bosses, tender on pressure, lying deep in the iliac fossa. The temperature was 101°. I suspected a lymphadenitis, and fearing that an abscess might form there I kept the patient in bed and under observation. There were no peritoneal symptoms, and by and by the swelling decreased spontaneously. I saw him last on May 25, 1915, there was still some thickening just inside of the external iliac artery, but it was hardly noticeable. By that time the epididymis had resumed its normal size and shape and all that could be felt was a small hard scar in the globus minor.

Interpretation of the findings In the class-ics on surgery and genito-urinary diseases, little is found about inflammations in the iliac fossa following simple epididymitis.

Casper¹ says that in gonorrhoeal epididymitis and deferentitis, extrapentoneal suppurations may occur in the iliac fossa, if the condition is attended by high fever, chills, etc., he recommends the incision of the abscess through the inguinal canal in order to prevent peritonitis, but he asserts that often the swelling will disappear spontaneously without causing any alarm. He evidently assumes that the inflammation of the vas deferens invades the tissues of the fossa ilaca simply by continuity. This view does not appear satisfactory in our two cases: first, in both instances the vas deferens seemed very little involved above the testicle, second, the abscess and the swelling observed were not at all at the point where the vas deferens crosses the iliac fossa to plunge into the pelvis, but distinctly higher, just inside of the external iliac artery, so I thought it would have to be accounted for in some other way and asked myself if the explanation could not be found in the anatomy of the lymphatics.

For our knowledge of the lymphatics we surgeons rely almost entirely on the anatomists, and it has been an axiom in all standard books on the subject since Sappey that the lymphatics of the testicle and epididymis all go to the lumbar or pre-aortic lymph nodes. This view is still held by such anatomists as Bardeleben (Bartels) 1909, Cunningham (1913), Quain (1914), Morris and Jackson (1914), Piersol, Gray and others. All agree that the lymphatics of the testicle and epididymis go to the lumbar lymph nodes and the lymphatics of the vas deferens and seminal vesicles to the external iliac (or retrocrural) and to the hypogastric lymph glands.

Horowitz and Zeissl² working in the laboratory of Professor Toldt in Vienna in 1890, undertook a very close study of the lymphatics of the testicle, by injecting the inner aspect of this organ they discovered a lymphatic vessel which follows the spermatic cord

through the inguinal canal and then empties itself not into the lumbar lymph-nodes but into a lymph gland situated in the iliac fossa, on the external iliac vein, below the crossing of the ureter.

Most³ and Jamieson and Dobson,⁴ seem to accept the observation of Horowitz and Zeissl as correct. Spalteholz (quoted by Hinman) in his atlas, pictures some lymph-channels going from the testicle to an external lymph-node.

Hinman⁵ in his paper on tumors of the testicle says "Not infrequently a gland is found in the region where the ureter crosses the iliac" and he insists that this somewhat secondary gland should also be removed along with the main lumbar and pre-aortic groups in radical operations for malignant growths of the testicle.

Cunéo,⁶ in 1912, states that most lymphatics of the testicle go to the lumbar and pre-aortic lymph nodes lying from the renal pedicle down to the bifurcation of the aorta, and in front of the vena cava, he made a special study of the new vessel described by Zeissl and Horowitz, as going to the external iliac glands, and he was able to inject it in ten cadavers so that he considers it as constant.

Testut and Jacob⁷ in their topographical anatomy (vol 2, Fig 454), assert that the lymphatic gland of Horowitz and Zeissl lies in the iliac fossa immediately inside the external iliac artery on the external iliac vein, below the crossing of the ureter, and that it receives a part of the lymphatics of the testicle.

So that we are forced to admit with the best modern authorities on the subject, that a part of the lymphatics of the testicle do not go to the lumbar lymph nodes, but do go to the so called gland of Zeissl and Horowitz belonging to the external iliac group.

We feel certain that our two clinical observations corroborate this view of the anatomists, in our first case the rounded

¹ Mod. On lymphatics of the testicle. Arch f Anat u. Entw. 1890 p. 113.

² Jamieson and Dobson. Lymphatics of the testicle. Lancet Lond. 1908, I, 493.

³ Hinman. Tumors of the testicle. J Am M Ass. 1914, December 5.

⁴ Foerster and Cunéo. The Lymphatics. 1912.

⁵ Testut et Jacob. Traité d'anatomie topographique 1914.

¹ Casper and Bonney. Genito-Urinary Diseases. 1909.

² Horowitz and Zeissl. Wien. med. Presse. xxxviii - 64. Wien klin. Wchnschr. 1890 p. 335.

swelling appeared at a point on the external iliac artery high above the inguinal region and, after suppuration was established, worked its way gradually downward toward Poupart's ligament. There was no sign of pelvic or spinal tuberculosis in this case, and the rapid cure effected by only four treatments by aspiration speaks against the presence of a bony focus which, it seems to us, would have kept up the suppuration a longer time.

In the second case the irregular and undulated surface of the swelling high in the iliac fossa strongly reminded us of similar glandular inflammations in the neck. As to such lesion being due to the action of the gonococcus (possibly with mixed infections?), the urologists seem to regard this as quite possible. Casper (*loc cit.*) mentions suppurations in the iliac fossa after gonorrhœal epididymitis, and Luys¹ says that gonorrhœal urethritis may cause a swelling and even a suppuration of the inguinal lymph glands. Grosz² writing on gonorrhœal deferentitis, says that "in cases of severe epididymitis the lymphatic vessel of Horowitz and Zeissl brings the infection into the external iliac glands. He has seen such inflammations ending sometimes in retroperitoneal suppurations, and in a few cases this has even resulted in peritonitis, as was proved by nine cases that came to autopsy."

The point to be remembered by the sur-

geon is that a part of the lymphatic channels of the testicle empty into the external iliac glands, and this explains the presence of certain inflammatory swellings and even abscesses in the iliac fossa after simple epididymitis (tuberculous or gonorrhœal) without any involvement of the scrotum.

If such trouble should appear in the right iliac fossa some time after an acute epididymitis, the surgeon will do well to be on his guard before making the diagnosis of appendicitis. If signs of suppuration are present, he will have to keep in mind the fact that the trouble is extraperitoneal and will have to plan his intervention accordingly. At the same time he must not wait until the pus has perforated into the peritoneal cavity.

He will also not trouble himself with the possibility of omental inflammation (as I did in one case) if he knows that the iliac swelling is consequent upon a gonorrhœal epididymitis.

If a large abscess of the iliac fossa should form in a man recently suffering from a simple tuberculous epididymitis, the surgeon will know that a better prognosis can be given here than if the source of the abscess were a tuberculous caries of the pelvis or of a vertebra.

Lastly, for those who believe in removing the tributary lymph nodes in malignant growths of the testicle, it will be just as essential to remove the external iliac group as the lumbar and pre-aortic lymph-glands.

¹ O. Luys. *Traité de la Hémorrhagie* 1902.

² Grosz in *Handbuch der Geschlechtskrankheiten*. By Finger, Jadassohn, Ehrmann, Grosz. Vol. II, p. 7.

THE OPERATIVE TREATMENT OF VARICOSE VEINS AND ULCERS, BASED UPON A CLASSIFICATION OF THESE LESIONS

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VARICOSE veins and their attendant ulcers have long offered and may continue to offer a fruitful field for surgical failures, and this not so much from the lack of effective weapons in the surgeon's armamentarium as from his failure to choose his weapon according to the strength of his opponent. The ligation operation of Trendelenburg (1), the multiple percutaneous ligations of Schede (2) and Kuzmik (3), the full dissection of Madelung (4), and the spiral cut of Rindfleisch (5), to mention a number of typical procedures, are methods of attack appropriate in varying degree to varix of the legs. In how far available or useful in a given case any one of them may be can be determined only by an exact knowledge of the circulatory abnormality which is present and it is reasonable, therefore, to consider whether varicose veins can be effectively divided for purposes of diagnosis and treatment into a number of groups, typical and easy of recognition.

NORMAL ANATOMY AND PHYSIOLOGY

The recognition and classification of this abnormal circulatory condition requires a consideration of the normal venous return from the lower extremities. The blood which is to travel from the feet to the heart must rise, when the individual is erect some four or more feet. The veins of the legs which conduct this flow are furnished with a considerable number of bicuspid valves, so set as to allow the blood to pass only toward the heart. In other words the vessels are divided into a series of chambers which can deliver their contents upward only. Every movement of the legs tends to compress the veins in one place or another and so forces the blood from one segment into the next above. One has only to stand still for a few hours to appreciate the discomfort of stasis brought about by the failure of muscular movement. The venous circulation will con-

tinue, however, though at a disadvantage, without such assistance. The vein walls are, normally, resilient, and, supported by the muscles and skin, will not stretch sufficiently to allow any important back flow past the valves. Under these conditions the gradual emptying of the vena cava brought about by variations of pressure in the thorax and the gentle push of the capillary circulation combine to keep the venous blood moving slowly on.

Unfortunately the great abdominal veins to which the blood is delivered from below have no valves. There is, then, a column of blood in these vessels unsupported save by the valves of the veins in the legs, a column drawn upward feebly by rhythmic alterations in intrathoracic pressure, but offering a considerable weight against which the blood from the extremities must rise, a column, in fact, subject to the changes of abdominal tension, and often, therefore, a menace to the integrity of the valves below it. To meet this strain, the veins of the legs are divided into two systems, the deep, among the muscles and well supported by them, and the superficial, lying in the subcutaneous tissues, and supported only by skin, superficial fascia, and fat. Of these two systems the former is considerably the more capacious and obviously the less liable to disability, while the latter, though it probably carries much less blood, is more exposed to trauma and derives far less support from the tissues outside its own vein walls. The two communicate by what are called perforating or communicating vessels, in which the valves are so set that blood can normally flow only from the surface veins to the deep. These perforating vessels, which vary considerably in number and distribution, offer, therefore, a safety valve for the superficial system (Figs. 1 and 2).

The surface veins may again be divided into two subsystems, the great or internal saphenous, and the lesser or external saphenous,

nous The great saphenous vein, after gathering radicals from the front and inner side of the foot and lower leg, passes upward, generally as a straight single trunk, inside the knee, along the inner anterior surface of the thigh, and into the femoral vein at the saphenous opening. The small or external saphenous vein drains the back and outside of the foot and leg, and empties in the popliteal space into the popliteal vein. It frequently communicates with its more important companion and, like it, is subject to considerable variation.

Distribution of valves. All the veins of the extremity are furnished with filmy, delicate, bicuspid valves. At infancy there are, between the foot and the groin, as many as fifteen to thirty sets in both great saphenous veins (Klotz, 6), but this number undoubtedly decreases even under normal conditions with advancing years. There is almost invariably a valve in the principal vessel just distal to each entering branch and one near the mouth of the entering vein as well. The valves of the deep and surface systems differ in no way from each other, and there is, more often than not, a valve in the femoral vein just above the point of entrance of the great saphenous. The arrangement of valves in the perforating veins, as has already been stated, allows of bloodflow toward the deep vessels only.

Summary of anatomic and physiologic considerations. The principal physiologic features, then, of the venous circulation in the legs are the following. The veins pass the blood upward through a series of chambers separated by bicuspid valves set to permit only an upward flow, thus flow is favored by movements of the leg muscles assisted by the forces in the thorax which tend to empty the vena cava, and by the push of the capillary circulation, the walls of the veins must support a column of blood whose height is measured by the distance to the heart above, and inasmuch as the abdominal veins are valveless, the pressure upon the upper valve, or upon the vessel walls below it if this valve becomes incompetent, may be enormously heightened by increase in intra abdominal tension, the deep veins of the legs have a

strong muscular support outside their own walls, while the surface veins derive an adventitious support only from the superficial fat and skin; a system of vessels perforating the deep fascia communicates between the two, and owing to the arrangement of its valves, lightens to some extent the work of the latter.

ETIOLOGY AND PATHOLOGY

Etiology. For all practical purposes a varicose vein in the lower extremities may be described as merely a valveless vein or more properly a vein whose valves are incompetent. Having in mind this fact, one may obtain from a study of the circumstances under which varicosity becomes established and a knowledge of the pathologic changes which necessarily ensue, an explanation of the various forms which varix assumes and a rational basis for treatment.

The most obvious cause of the breaking down of the valves is hard work, by which I mean carrying or lifting heavy loads for long periods, as in the case of longshoremen, freight handlers, and laborers. The tension upon the abdominal muscles, the downward push of the diaphragm in violent breathing, in fact, the same strain which produces hernia, lays a heavy load upon the veins of the legs. Whether the valves become useless through stretching of the vein walls or are directly broken is immaterial. The occupations which involve standing for long periods without moving the legs are, in a lesser degree, a source of valvular incompetence, and this not from excessive back pressure but from stasis due to lack of muscular movement. Among women, the venous engorgement of the legs so often seen even early in pregnancy may, finally after the birth of several children, result in varicosity. I have also seen, in young men, and in young women who have never borne children, instances of varix which date from childhood, apparently due to congenital abnormalities. All these etiologic factors tend to produce the well known, large, surface varicosities.

A second and smaller group of cases arises from phlebitis. The "milk leg" after labor, the phlebitis of typhoid and of post-operative

convalescence all give rise to varix which can generally be distinguished from that due primarily to engorgement. The reason for this distinction becomes more clear when one considers the series of pathologic changes characteristic of the onset and establishment of varicose veins.

Pathology. It seems to be true, without going into the more minute pathologic anatomy, that varix may assume one of two principal forms, depending in a general way upon whether it results from overstrain and stretching of the vein walls, or from phlebitis. In the first case, the valves gradually become functionless, the vessel walls stretch until their nutrition is impaired, muscle-cells become replaced by inelastic scar tissue, the vein becomes tortuous, local areas distend into pockets, calcification sets in, and indeed, all the variations commonly observed in scar-tissue, ill-nourished and under tension, are likely to occur. As the onset of these changes is naturally gradual, effective collateral circulation corresponding to the degree of stasis in the main channels is frequently established, and true varicosity is often confined to the trunk and principal branches of the great saphenous vein.

The ulcers which occur under these circumstances are almost without exception in direct relation to the varicose vessel or vessels. They are said to "ride" upon veins, occurring almost exclusively in the lower and middle thirds of the lower leg. Fundamentally their occurrence seems to be due to a chronic irritation of the skin associated with stasis of impure blood in the vein beneath, as attested by the pigmentation which so commonly precedes them, but a frequent contributory cause is undoubtedly trauma, and the form which they ultimately assume must depend greatly upon the degree of infection which follows their establishment.

The perforating vessels do not usually share in the varicosity of the large tortuous veins. In many instances they continue for years to fill their rôle of safety valves, carrying the stagnant blood from the surface veins into the deep system which is well able to care for it. When, however, they in turn become dilated the surface circulation be-

comes the more embarrassed in that blood may now pour out from the deep veins to the superficial. Under the circumstances ulcers are particularly prone to occur and that over areas independent of the veins themselves.

The first and more common variety of varicose vein is, then, dilated, sclerotic, tortuous, often sacculated and calcified. It is not necessarily associated with very noticeable changes in the nutrition of the leg, owing to the effectiveness of collateral circulation and the preservation of the useful perforating veins. Ulcers when present usually "ride" upon the principal varicose trunk. In the more advanced cases, particularly when the perforating veins have become incompetent, the general nutrition of the leg may be poor, and ulcers may develop over wide areas.

The second and less common variety of varicose vein arises from phlebitis. In this case the valves are suddenly and universally crippled, possibly by the organization of the thrombus, the vein walls are thickened and the lumen narrowed. The circulation through such a vessel is just as ineffective as through a large dilated channel. Ulcers often appear within a few weeks or months of the phlebitis. The great saphenous vein is almost invariably small, hard, straight, and thick-walled, but there are occasionally seen groups of very thin-walled surface branches as if a collateral circulation had been rapidly established and distended. The perforating veins are nearly always incompetent. The disturbance of the surface circulation is so profound that ulcers are often multiple and widely scattered over the lower leg. The skin and subcutaneous tissues over the whole calf and shin may become a mass of adenomatous scar-tissue. The foot, however rarely shares this appearance. Apparently it is well cared for by the deep vessels, perhaps aided by the support of the shoe.

CLASSIFICATION OF VARICOSE VEINS

From an etiologic standpoint varicose veins should be divided into two groups, the first comprising those arising by gradual dilatation and the second, those which take origin

in phlebitis. For purposes of treatment, however, this classification is unsatisfactory and it is better to divide them into: (1) surface varix, and (2) surface varix complicated by varicosity of the perforating veins. In the first category belong the large majority of instances of gradual dilatation and incompetence, and in the second, not only some of the more advanced cases of similar etiology, but almost without exception the cases of varicosity arising suddenly from phlebitis. Certain simple diagnostic measures distinguish these groups, which may, and usually do, demand characteristically different treatment.

Clinical tests. The methods by which the true nature of varicose veins was first effectively demonstrated were devised by Trendelenburg (1), who showed that in varix there is nothing to prevent a back flow of blood in the veins, and actually measured the pressure which the long column of blood exerted against the vessel walls in the leg. The tests devised by Trendelenburg are easily performed. The leg is raised and held above the level of the heart until the veins are empty. It is then rapidly lowered when the blood can be seen to flow back into the leg and suddenly distend the surface vessels. This test for varicosity may be positive even when the reflux cannot be seen to distend the vein walls, for if the veins are so sclerosed that no change in the tension of their walls can be noted by the eye, it can quite readily be felt by the fingers.

By such means, valvular incompetence of the surface veins as opposed to hypertrophy or distention of normal vessels can be diagnosed, but still more information may be derived from a variation of the same simple procedure. Suppose it has already been determined that the surface veins allow a free back flow. The leg is now raised and the veins emptied of blood. If, before it is lowered, a constriction only firm enough to compress the surface vessels, as by a piece of bandage, is made about the upper thigh, blood cannot flow from above into the varicose superficial veins, and until they are filled by the natural circulation they remain empty.

This, French writers have called the *contre épreuve* of the Trendelenburg test, and it confirms the diagnosis, for on releasing the constriction, the empty or partially filled veins become distended with a palpable shock. But this procedure tells even more. Suppose the perforating veins share the varicosity of the surface vessels. The blood in the deep veins will then be able, as normally it cannot do, to leak into the surface vessels, and in applying the constriction test it will be found that in spite of the prevention of back flow down the superficial veins, these fill rapidly below the constriction. That is to say, blood is finding its way out from the unobstructed deep veins through incompetent perforating vessels to the surface. In varicosity of the surface veins alone, filling below the constriction takes place in three-quarters of a minute or more and even then these vessels may not be very tense, for the perforating veins are continually carrying off the excess of blood. If, on the other hand, the perforating veins are incompetent, the surface vessels will fill below the constriction, possibly in ten, twenty, or thirty seconds, according to the importance of the leak.

These two tests, which I shall hereafter call respectively the Trendelenburg test and the constriction test for perforating veins, serve to separate the cases of pure surface varicosity from surface varicosity complicated by varicosity of the perforating veins. The tests ignore the possibility of varix of the deep venous system, a very rare condition if indeed it is ever fully developed.

SURFACE VARIX

Distinguishing features (Fig. 3). This condition is distinguished by the demonstration of a free back flow down the surface veins (a positive Trendelenburg test) and by the failure of the lower surface veins to fill in the application of the constriction test for incompetent perforating vessels (a negative constriction test). In the performance of the second test, three quarters of a minute to a minute is taken as the normal filling time for the varicose surface veins below the constriction. A more rapid filling indicates some incompetence of the perforating chan-

nels In some cases of pure surface varicosity, however, the superficial veins never fill completely below the constriction apparently because they are effectively drained by the communicating veins. Such cases are often distinguished by a single enormous, tortuous, great saphenous trunk passing from groin to ankle, but even in instances of very general surface varix the effectiveness of the collateral circulation and perforating channels in caring for the stagnant surface blood is often surprising.

The diagnosis of varicosity restricted to the surface veins is not difficult except, first in the borderline cases in which the superficial veins fill slightly more rapidly than normally in the constriction test, and second, when there is a dense area of scar-tissue as a result of a long-standing ulcer in the lower leg. In the first instance it is better to consider that the perforating veins are, in fact, incompetent. In the second, a negative test for varicose perforating vessels means nothing, for the dense scar-tissue may effectively conceal the local reflux of blood from the deep channels. Under these circumstances the diagnosis can be established only at operation.

Operative procedure in surface varix. Relatively simple surgical measures may be employed to cure pure surface varices and the least radical of these is the so called Trendelenburg operation. The original operation was a simple ligation of the great saphenous vein in the thigh and was intended to relieve the veins below the ligature of back pressure due to the long column of stagnant blood. It has been modified into the excision of a short piece of vein between ligatures in order to prevent the reestablishment of a channel, and this excision is performed as close as possible to the saphenous opening. The main trunk of the great saphenous may even be divided in several places (Schwartz 7), cutting it up into a number of isolated segments in which the blood soon organizes and obliterates the lumen.¹

The Trendelenburg type of operation is to be advised as a palliative measure in

instances of varicosity of the great or lesser saphenous veins only when the perforating veins are proved to be competent. Inasmuch, however, as the great vein is not actually removed and not necessarily obliterated, there is always a fair chance of recurrence through the reestablishment of its channel by the aid of collateral circulation or by the formation of new veins in the scar-tissue separating the ends of the divided segments. Therefore the operation should only be performed upon the aged or infirm, or perhaps to tide a young person over a difficult period, or indeed, merely to heal an ulcer temporarily. An analysis of the results of this operation in the hands of various surgeons shows an anatomical recurrence after five years in 60 to 70 per cent of the cases, but with symptomatic recurrence in only 20 to 30 per cent (Miller, 8).

The radical operation, and one to be advised for the cure of the common surface varix without the involvement of the perforating vessels, is Madelung's full excision of the great saphenous vein. The exact method of performing this operation is less to be considered than a general scheme which will satisfy the following requisites first, that the great saphenous vein (and the lesser if involved) should be eradicated in such a way that there is no possibility of the reformation of its channel or the formation of a similar channel, second, that the ulcer or ulcers if present be permanently healed, third, that the wound or wounds should heal soundly and not interfere with the nutrition of the skin.

The radical removal of the surface veins is perhaps most satisfactorily performed upon the following plan. A transverse incision several inches long is made in the groin about an inch below Poupart's ligament. Through this incision the great saphenous vein is divided at the saphenous opening. At the same time any other veins which parallel it or enter from above are found and divided in order to do away with any vessels capable of reestablishing a large, single collateral trunk. The internal saphenous is then dissected out with the Mayo stripper or other appropriate means down to the region just

¹ Recently Kuznick (3) has made use of an operation originally devised by Schede (5) which consists in percutaneous ligation of the great saphenous vein at short intervals throughout its entire length. No incisions are made. Convalescence is short and the results are said to be good.

below the knee. At this point open dissection should begin, for here the larger branches of the great vein begin to enter it, and though breaking the long column of blood by removal of the internal saphenous from groin to knee is likely in many instances to cure, it is always advisable carefully to dissect out the varicose vessels of the calf down to the point where they appear small and harmless. This is most easily done by a long incision to the deep fascia, turning back thick flaps of skin and fat, and dissecting the veins from inside the flaps.

The fulfilling of the second requisite, the cure of the ulcer, depends for its success principally on the accomplishment of the first, that is, the complete removal of the veins. It is often advisable, however, in removing the largest veins to take with them what may be called their tributary ulcers. Moreover, as was first pointed out in this country by the Mayos (9), if in association with the ulcers there has been found a very thick impenetrable base of scar-tissue, it is almost always necessary, in order to secure healing of the ulcers, to remove with them down to, or better, through the deep fascia the mass of scar-tissue beneath and about them, otherwise the poorly nourished tissue may harbor a leaking perforating vessel not disclosed by the tests and may never permanently heal. In consequence of lying bare this oftentimes enormous area, an immediate skin graft (Thiersch preferably) completely covering the denuded surface should be performed, and it is notable that such grafts "take" well upon fat, fascia, or even periosteum.

Finally, in securing the third requisite the adequate nourishment of the skin and the proper healing of the wound after the dissection required by these procedures, perfect asepsis, perfect hæmostasis, and delicate handling of tissues are of the first importance. In this respect the method of making thick flaps of skin and fat is particularly useful and rather than exert much traction on the flaps it is always better to make a transverse incision at the lower end of the long wound, half way round the leg if necessary, in order to secure greater ease of dissection. It is

also a good rule to use one set of dissecting instruments for the early part of the operation upon the thigh, a second set for the dissection of the calf, and a third set for closure of the wounds in the thigh, if closure has not been effected before the dissection of the lower leg. The selection of fresh instruments is highly desirable inasmuch as forceps must almost of necessity become contaminated by handling the borders of incisions, particularly in scarred and often-ulcerated tissues of low bacterial resistance. Finally, it is generally advisable to close all wounds subcutaneously with interrupted catgut stitches and in the lower leg to close incisions very loosely, making use of no superficial skin sutures whatsoever.

SURFACE VARIX COMPLICATED BY VARICOSITY OF THE PERFORATING VEINS

Distinguishing features (Fig. 4). The cases falling under this head differ very considerably from each other in appearance. Varicose vessels may be numerous and prominent, or few and almost invisible. In the second instance, the patient's discomforts are strikingly greater than the apparent degree of varicosity warrants. Ulcers, particularly in those whose circumstances prevent them from nursing their ailments, are common. The constriction test shows that the surface vessels fill rapidly below the constriction by way of the varicose perforating channels. Nevertheless the findings may be difficult to interpret.

The simplest and perhaps least common cases are those having the appearance of advanced surface varix, perhaps without any marked formation of scar-tissue about the veins and in the subcutaneous tissues in general. More difficult to classify are those patients whose surface vessels are equally varicose but whose perforating veins are only incompetent after long standing, recovering their function after some days rest in bed. Most difficult of exact diagnosis are the instances of great obesity when the veins can barely be distinguished by palpation, and those cases of phlebitis, in which the great saphenous vein is small, thick walled, and

palpated with difficulty amid the indurated and œdematous tissues of the lower leg. Even an expert sense of touch may then fail to note the emptying and filling of the veins unless some good sized surface branch happens to be at hand. The Trendelenburg test is oftentimes not immediately positive—that is to say, the blood does not pour down the veins with a shock, but fills them in a few seconds—and the constriction test is positive after a somewhat longer interval. Occasionally the veins are so small, hard and obscured by scar-tissue that the exact character of the venous reflux can be observed in them neither by sight nor by palpation and one must infer the diagnosis by observing the absence or presence of cyanosis in the lower leg during the performance of the tests.

Paradoxical law of varicose veins Straight small, thick walled veins of the post-phlebitic type are almost unnoticeable, yet the lesions which habitually mark their presence—ulcers, œdema, atrophy of the skin—are obstinately resistant to treatment, and it may perhaps be stated as a law, that the less noticeable the veins, the more malignant and resistant the accompanying ulcers, and the more radical and thorough must be the curative operation. Large tortuous surface varicosities are gradually established, perforating vessels and collateral circulation are then usually competent, ulcers if present ride on veins, and cure is usually easy. On the other hand, the varicosity of the small sclerosed surface vessel is rapidly established by inflammatory processes, collateral circulation is ineffective, perforating veins are almost invariably crippled, disturbances in the skin are widespread and severe, and cure is correspondingly difficult.

Operative procedures It is in the treatment of these complicated conditions that the adaptation of the surgical procedure to the individual case is so important and accordingly, after indicating in a general way what seem to me ideal principles, I shall cite a number of instances from the Peter Bent Brigham Hospital series in which operative variations have been adopted. In simple surface varix it is seldom necessary to do

more than remove the great saphenous vein from groin to mid calf. In surface varix complicated by varicosity of the perforating veins, not only must the great saphenous be eradicated but many of its branches in the calf must be followed and excised in the search for incompetent perforating channels. If these channels are not ligated they will continue to remain a source of venous stasis, and inasmuch as they are frequently found beneath ulcers in the center of great masses of scar tissue, their removal is generally as difficult as it is imperative.

All such operations require the usual transverse incision below Poupart's ligament and resection of the great saphenous vein in the thigh. When the lower leg is not so densely indurated as to forbid free dissection of the calf, large, thick flaps should be turned back after the method of Madelung to expose the deep fascia of the front and inner side of the leg. The surface veins are dissected from the internal surface of the flaps and in this dissection the varicose perforating vessels are likely to be found (I have never recognized in the calf more than three, seldom more than two). They are tied beneath the deep fascia. When an area of scar-tissue is encountered, whether or not it is the seat of ulcer, the judgment of the operator must determine the thoroughness with which this tissue shall be dissected. If an ulcer is present, the whole mass of scar-tissue is best excised and its base skin grafted. If ulcers have formerly existed and healed, a linear cut may be made through the indurated region and flaps turned back as usual. In this case the wound should be very loosely approximated.

In some instances, however, the whole leg below the knee is so œdematous, indurated, and covered with ulcers that not only is the resection of the principal surface vessels a difficult matter, but the turning back of skin flaps for thorough dissection is impossible. It is under these conditions that the spiral cut of Rindfleisch is perhaps indicated, though I prefer to make multiple incisions, either transverse as a modification of the "garter" operation of Schede, or perhaps more safely in a perpendicular direction. Indeed, it is

wisest if the operator has the confidence of his patient, after doing away with the great saphenous vein above the knee, to work up the leg making multiple incisions at several sittings, picking up and tying one by one the varicose perforating channels as one passes up the leg after the method of Novaro (10). In any case the object of the operator should be, I believe, to abolish the continuity of all surface veins of any considerable size, and to find and divide, or at least cut off from the surface circulation, the varicose perforating veins. If this is accomplished, the superficial circulation is carried on by small vessels emptying probably by way of devious connections in the thigh. The skin of the lower leg may perhaps remain dermatous but ulcers will not tend to recur. The operator must keep in mind that tissues served by almost invisible channels are better off than those drained by a varicose vessel.

CIRCULATORY ABNORMALITIES OF THE GREAT SAPHENOUS VEIN

The great saphenous vein is limited to the thigh. The lower leg is then drained by one or more trunks similar in distribution to the lesser saphenous, perforating the deep fascia above the knee and joining the deep veins in the thigh. This abnormality has been twice noted at operation in the Peter Bent Brigham Hospital series of about seventy cases. It is difficult to diagnose, however, as the great saphenous in the thigh lies so deeply embedded in fat and is often so difficult to trace that its failure to connect with the varicose vessels of the calf is overlooked. The signs due to this abnormality are similar to those of varix of the lesser saphenous, that is, the veins in the lower leg fill with the same rapidity whether or not a constriction is applied to the mid thigh, but may fail to fill upon the application of the constriction test at the level of the knee. At operation the great saphenous is found to end above the knee and a large varicose trunk, passing upward to perforate the deep fascia in the thigh, is encountered in the dissection of the inner side of the lower leg.

The great saphenous vein is double. This abnormality should be kept in mind and may

account for some operative failures especially after insufficient dissections. It has not been noted in the Brigham Hospital series, though recorded by others.

VARIX OF THE LESSER SAPHENOUS VEIN

Varix of the lesser saphenous vein unaccompanied by varix of the great saphenous. This is an unusual condition and has occurred four times in this series. The diagnosis is fairly obvious as the varicose veins are confined to the back and outside of the lower leg and do not extend above the popliteal space. The Trendelenburg test is positive. The constriction test if applied in the mid-thigh is equally positive, but if the constriction is applied below the point where the lesser saphenous enters the deep fascia it is positive or negative according as the vein has or has not varicose perforating connections below. The treatment is radical excision. Ulcer, if present, is close above the heel and is best excised with the vein.

Varix of the lesser saphenous vein accompanying varix of the great saphenous. This condition is not at all uncommon. The varicosity of the lesser saphenous may perhaps arise independently, but seems more often to be due to communication with the larger vessel. The diagnosis between these two conditions can usually be made by finding whether or not the branches of the two systems show similar or independent reactions to the usual tests. In either case the treatment includes excision of the lesser saphenous trunk for several inches at least below and above its varicose connection with the great saphenous.

GENERAL CONSIDERATIONS IN REGARD TO CLASSIFICATION AND TREATMENT

Not all instances of varix appear to fall under the classification here referred to. A not uncommon condition is that of moderately developed superficial varicosity in which the veins are shown by the Trendelenburg test to be only partially incompetent and there is no tendency to ulcer formation. The patient's discomfort is, however, great, particularly upon standing for long hours, and I have the impression that under these cir-



Fig 1

Fig 1 The superficial veins. The great saphenous and its branches. Notice the region of the perforating vessels.

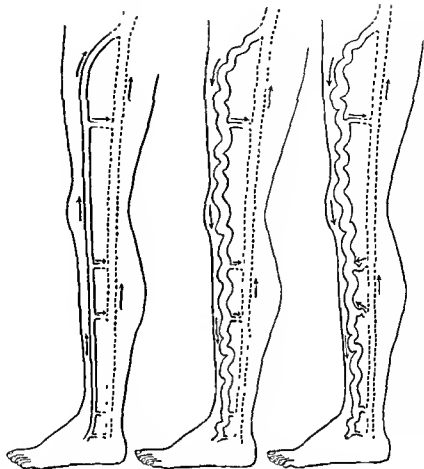


Fig 2

Fig 3

Fig 4

Fig 2 Diagram showing normal direction of blood current in the superficial and deep systems. Notice directions of current in the perforating vessels.

Fig 3 Diagram showing direction of blood current in superficial varix with normal perforating vessels. The perforating veins drain the surface vessels.

Fig 4 Diagram showing direction of blood current in superficial varix with incompetent perforating vessels. The perforating veins add to the disability of the surface vessels.

circumstances varicosity in the great saphenous is in the process of development and that collateral circulation is as yet unestablished. Such cases are probably ill adapted to radical operation inasmuch as removal of the only partially incompetent great saphenous vein is likely to throw a sudden strain upon the smaller surface vessels with resulting dilatation, general oedema and possibly ulceration of the skin. One case of this kind in the Brigham series was subjected to operation, and

though the result at the end of a year appeared excellent, there was at first considerable swelling oedema and added discomfort.

Another and more uncommon deviation from the usual types is seen in local dilatation and advanced sclerosis in certain groups of vessels unaccompanied by any noticeable change in the great saphenous in the thigh. Here the Trendelenburg test will show that the main channel is indeed varicose though it can neither be seen nor felt. In one such



Fig. 5 Case 1. N. A. McIl. Surface varix. Note large size and tortuosity of single varicose vein. Ulcer rides on vein.

instance it was found that the great saphenous in the thigh, though valveless and irregular in caliber, was small and thin walled. Its large branches above the knee were abnormally numerous and one of these could be followed down the leg to the foot as a typically varicose vessel. A group of markedly varicose veins in the lower leg communicated with it.

Such are some of the variations from classic types which have been noted in the Brigham series. It is safer to regard such unusual cases as subjects for the most careful study and exploration. Exploratory incision and examination of the great saphenous vein in the groin may be required to establish the diagnosis. How far syphilis may play a part in the unusual as well as in the more common varieties of varix is difficult to say. Wassermann reactions have been almost universally made in this series and have almost invariably been negative. The mere existence of syphilis neither proves that disease is etiologically important in varix nor



Fig. 6 Case 1. Surface varix. N. A. McIl. After operation. The transverse incision in groin does not show. Two years after operation.

is its cure, if present, likely to influence to any extent the mechanical deficiencies of fully established varicose veins.

Preparation of patients for operation and after care. All patients with varicose veins are best kept in bed for several days before operation. No special attempt need be made to render the skin sterile except the usual wash and shave the evening before operation. Moreover it is quite unnecessary, except in unusually advanced cases, to wait for the healing of ulcers, for the ulcer area can be kept covered during the dissection of sound tissues, and when included in the operation it is either excised or transected and loosely closed.

After operation the ankle and knee should be immobilized by a crinoline bandage with or without a hair splint. Immobilization need not be maintained longer than a week, but a firm bandage should be applied to the calf, especially when the patient is very obese, for two weeks in all. At the end of this time, if the incisions are well healed the leg should be exercised in bed and the patient may begin

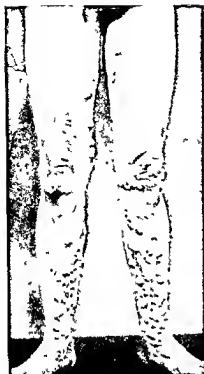


Fig 7 Case 2 Surface varix F J C Note huge surface vein in right thigh and general enlargement of veins of calves The great saphenous vein in the left thigh has been removed at a previous operation The small saphenous vein is keeping up the class in the surface veins of the left calf



Fig 8 Case 2 Surface varix T J C After operation Right leg, usual incisions for excision of great saphenous vein Left leg note long postero-external incision for excision of lesser saphenous vein

to get up Upon beginning to walk a supporting bandage from toes to knee should be worn for several weeks After this time all bandages should be discarded for they may if tightly applied be actually harmful

PROTOCOLS OF ILLUSTRATIVE CASES¹

CASE 1 Surface varix Surgical 280 N A McD, female age 30 (figs 3 and 6) Duration of disease five years in right leg only Etiology gradual onset with childbearing Ulcer present of four months duration—rides on vein little induration Trendelenburg test positive filling immediate Constriction test for perforating veins negative filling below constriction incomplete in 35 seconds

These cases are not selected as typical end results In some of them the ideal operation is indicated in comment upon the procedure employed In others the procedure is described as illustrated which experience has shown to be ideal though the operation is of recent date In a critical study of this kind improvements in technique have necessarily waited upon the observation of early successes and failures At a later date an analysis of the entire series with end results will be published

Operation July 31 1913 Transverse incision in groin Stripping of vein in thigh Stripping of two principal branches in calf just above ulcer which was not excised Result, June 28, 1915 No return of symptoms Perfect result (See Fig 6)

NOTE—In view of the nature of the ulcer in this case the failure to excise it is perhaps justifiable, though it might have been excised with the principal vein

CASE 2 Surface varix Surgical 3131, F J C, male age 50 (figs 7 and 8) Duration of disease nine years in both legs Etiology heavy lifting (freight handler) Ulcer present off and on for 7 years Second ulcer recently following a palliative operation Trendelenburg test right positive, filling immediate, left, positive filling in 6 seconds Constriction test for perforating veins right negative, filling below constriction in 45 seconds left (constriction in mid thigh) positive, filling below constriction in 20 seconds, left (constriction over popliteal space), negative filling below constriction in 45 seconds

NOTE—These tests upon the left leg place the incompetent perforating vein in the upper part of the popliteal space and suggest the small saphenous



Fig. 9. Case 4. Surface varix with varicosity of perforating veins. Large vessel type. F. M. D. Lateral view of right leg.

vein as the offender. This was proved at operation to be the case and explains the failure of the previous operation.

Operation. June 28, 1915. (A previous local operation at another institution had been performed upon the left leg a year or two before with multiple divisions of the great saphenous vein. The clots in the isolated segments became infected so that the great saphenous trunk in the thigh was for the most part removed yet a new ulcer occurred and the veins of the calf never diminished in size as shown in the accompanying photograph. They undoubtedly were filled from the varicose small saphenous vein. The patient had fully realized the probability of failure from this palliative operation which the surgeon had performed under protest to relieve immediate distress.)

Right leg: transverse incision in groin, stripping and free dissection of vein in thigh, dissection of calf (narrow flaps) and excision of strip of skin adherent to veins. Left leg: transverse incision in groin, removal of a short segment of vein above the upper incision of the former operation. Long incision inside calf (narrow flaps), excision of many varicose vessels some passing backward toward small saphenous vein. Second long incision to mid line posteriorly (narrow flaps). Excision of varicose small saphenous vein nearly to ankle and of several varicose branches which had evidently



Fig. 10. Case 4. Surface varix with varicosity of perforating veins. Large vessel type. F. M. D. Posterior view.

communicated with the great saphenous in the calf. Immediate result: Healing (Fig. 8).

CASE 4. Surface varix with varicosity of perforating veins. Large surface vein type. Surgical 2973. F. M. D. female, age 30 (Figs. 9, 10, 11, 12). Duration of disease 8 years. Etiology: child bearing gradual onset in both legs. Ulcer recently in right leg over an area of thrombosis in calf. Trendelenburg test: right, positive; filling in 5 seconds; left, positive; filling in 15 seconds. Constriction test for perforating veins: right, positive; filling below constriction in 20 seconds; left, doubtful; filling below constriction in 30 seconds.

Operation. May 28, 1915. Right: transverse incision in groin, stripping vein in thigh to knee, full dissection of calf with wide flaps, excising thrombosed vessels and area of poorly nourished skin. Two incompetent perforating veins found and ligated. Left: transverse incision in groin, stripping vein in thigh, dissection of calf (narrow flaps), removal of many large branches including upper portion of small saphenous vein which was particularly varicose.

Result. (Figs. 11 and 12) immediate healing.

CASE 5. Surface varix with varicosity of perforating veins. Post phlebotic—small vessel type. Sur-



Fig. 11 Case 4 F M D After operation Compare with Fig. 9



Fig. 12 Case 4 F M D After operation. Note incision in each popliteal space for resection of each small saphenous vein, and large flap on back of left calf. Compare with Fig. 10

gical 416 M N female, age 20, single (Fig. 13). Duration of disease discomfort for 14 years. Has never noticed enlarged veins. Etiology severe burn of body in childhood both legs swollen and painful at this time, probably phlebitis. Ulcer for 2 years in both legs. Trendelenburg test positive filling in 10 to 12 seconds. Constriction test for perforating vessels positive, filling below constriction in 22 seconds.

Operation, October 1, 1913. Transverse incisions in groins, stripping in thighs, broad flap dissection of both calves with transverse incisions above ulcer areas, ulcers not excised. (No note of condition of perforating vessels.) Immediate healing later, reported recurrence of ulcers.

Result, June 20, 1915. Patient reports herself well. Not seen as she had left the city.

NOTE — Possibly incomplete operation. Incompetent perforating vessels may exist beneath ulcers. Ulcer areas should have been excised down to sound tissue. Elapsed time after operation (2 years) too short to be certain of cure under the circumstances.

CASE 6. Surface varix with tortuosity of perforating veins. Post phlebitic—small vessel type. Surgical 2007 P T male age 35 (Figs. 14 and 15).



Fig. 13 Case 5 M N. Note large discolored areas and ulcers and absence of visible varicose veins.



Fig. 14. Case 6. P. T. Surface varix with varicosity of perforating veins. Small vessel type, post phlebotic. Note large ulcer area upon right leg and absence of visible varicose veins.

Duration of disease 4 years in right leg. Etiology injured leg 4 years ago. Phlebitis at this time (?). Patient is a stationary fireman. Heavy lifting, long hours on feet. Ulcer, for 4 years. Irregular unhealthy granulations. Trendelenburg test positive filling time 2 to 4 seconds. Constriction test for perforating vessels negative filling below constriction in 45 seconds. An extensive scar prevents accurate test.

Operation November 5, 1914. Transverse incision in groin stripping vein in thigh, broad flap dissection of calf, excision of ulcer. Large perforating varicose vein found beneath ulcer. Secondary skin graft (Reverdin), (Fig. 15). Immediate result good, slow convalescence.

Result, July 29, 1915. Perfect, patient at work, skin of calf including grafted area looks healthy.

NOTE—Larger area should have been excised and grafted at once, but ligation of the perforating vein beneath the ulcer made the cure almost certain.

CASE 7 Surface varix with varicosity of perforating veins. Post phlebotic—small vessel type. Surgical 419. J. M., male, age 52. Duration of disease 2 years. Has never noticed enlarged veins. Etiology phlebitis accompanying typhoid fever. Ulcer, multiple, scattered over a reddened edematous lower leg. Appeared immediately after recovery



Fig. 15. Case 6. P. T. Nine months after operation. Note grafted area and character of incision in calf. The incision in the groin is partly in shadow and does not show. Compare with Fig. 14.

from typhoid and never healed even after three weeks rest in bed. Trendelenburg test. Positive filling time, 1 to 2 seconds. Constriction test for perforating veins positive filling below constriction in 1 to 2 seconds.

Operations September 26, 1913. Transverse incision in groin. Stripping in thigh (small thick walled straight vessel). Flap dissection of upper calf. Two transverse incisions half encircling leg. Several incompetent perforating veins found October 2, 1913. Several more transverse incisions interdigitating with first set. Healing April 9, 1914. Return of 2 ulcers. Further transverse incisions. Immediate healing.

Result, November 9, 1914. No ulcers, no pain, steadily at work, wears a light bandage.

NOTE—This case would perhaps have been suitable also for a spiral incision. In my opinion short incisions at several sittings are more satisfactory.

CASE 8 Surface varix with varicosity of perforating veins. Post phlebotic small vessel type. Surgical 1950. T. C., male, age 38 (figs. 16 and 17). Duration of disease 7 months. Has never noticed enlarged veins. Etiology phlebitis following pneumonia 3 years ago. Ulcer present for 7 months, multiple (4) in large edematous scar like area. Trendelenburg test positive filling in 1 to 2 seconds.



Fig 16 Case 8 T C Surface varix with varicosity of perforating veins. Small vessel type post phlebitic. Note multiple ulcerations and absence of visible varicose veins.



Fig 17 Case 8 T C At close of operation. The great saphenous vein has been excised in the thigh. Note distribution of incisions and loose closure of wounds.

Constriction test for perforating veins positive, filling below constriction in 20 seconds.

Operation October 25, 1914. Transverse incision in groin stripping thigh full dissection of calf with flaps. Straight thick walled small saphenous vein. Several incompetent perforating veins found. Multiple incisions (longitudinal through ulcers), partial resection of small saphenous vein (slough occurred on back of calf near this incision).

Immediate result good. Ulcers healed. Late result July 26, 1915. This case like the previous one required multiple incisions at several sittings. This was explained to the patient but he has not returned to the hospital. He is known however to have two ulcers instead of four. The result is a failure in that ulcers are still present and illustrates the difficulty of treating such a condition without the cooperation of the patient.

CONCLUSIONS

1 Varicosity of the veins of the legs is confined for anatomic and physiologic reasons to the superficial and perforating vessels.

2 Trendelenburg's tests distinguish between pure surface varix and surface varix

complicated by varicosity of the perforating veins, a distinction important for purposes of treatment.

3 Surface varix is curable by relatively simple surgical procedures, preferably excision of the great saphenous vein from groin to mid calf.

4 Surface varix complicated by varicosity of the perforating veins requires for its cure not only eradication of the great saphenous vein but a thorough exploration of the lower leg in order to ligate varicose perforating veins.

5 Varix following phlebitis is not uncommon. It presents a characteristic appearance, is prone to be complicated by varicosity of the perforating veins, and is usually accompanied by obstinate ulceration soon after its establishment.

6 It is a very general rule if not a law, that the more prominent and tortuous the surface veins the simpler the cure, the less

noticeable the surface veins the more malignant and resistant their attendant ulcers and the more radical the operative procedure required for cure.

7 Varicose ulcers, if of long standing and especially if they are surrounded by an area of thick scar-tissue, are best treated by free excision and immediate skin graft in connection with the radical removal of the veins to which they are tributary.

BIBLIOGRAPHY

- 1 TRENDLENBURG Ueber die Unterbindung der Vena saphena magna bei Unterschenkelvaricen Beitr z klin, Chir. 1890, VII, 105
- 2 SCHIFFER Ueber die operative Behandlung der Unterschenkelvaricen Berl klin Wchnschr, 1877, XIV, 83
- 3 KLEWIK Beitrage zur operativen Behandlung der Venenkrankheiten der unteren Extremitäten Beitr z klin Chir, 1913 LXXXI, 1
- 4 MADRONE Ueber die Auschaltung einzelner Varicen an den unteren Extremitäten Verhandl d deutsch Gesellsch f Chir 1884 XIV, 184
- 5 THEODOR (Rindfleisch) Operative Behandlung der Varicen Elephantiasis und Ulcus Cruris Arch f klin Chir 1908 LXXXVI, 143

- 6 KLOTZ Untersuchungen ueber die Vena saphena magna beim Menschen rucksichtlich ihrer Klappenverhältnisse Arch f Anat u. Physiol, 1889, p 137
- 7 SCHWARTZ Du traitement des varices par la ligation multiple de la veine saphène interne et l'ectomie. Rev gén de clin et de therap, 1888, II, 63
- 8 MILLER The results of operative treatment of varicose veins of the leg by the methods of Trendelenburg and Schede Johns Hopkins Hosp Bull, 1906, XVII, 280
- 9 MAYO, C. H. Treatment of varicose veins Surg, Gynec & Obst, 1906 II, 385
- 10 MORO (Novaro) Ueber die Pathogenese und die zweckensgemäße Behandlung der Krampfadern der unteren Extremitäten Beitr z klin Chir, 1910 LXVI, 470

GENERAL REFERENCES

- REMY, CH. Traité des varices des membres inférieurs 1901
- LEDDI RHOSE Studien ueber den Blutlauf in den Hautvenen unter physiologischen und pathologischen Bedingungen Mitt a d Lärzgebh d Med u Chir, 1906 XV, 355
- CHÉVRIER De l'examen du reflux veineux dans les varices superficielles Arch gén de chir, 1908 II, 42
- BENNETT Varices, causes, treatment The Lancet Lond, 1808, II, 673
- ALGRAVE, P. Resultats immédiats et éloignés de la résection totale des varices essentielles superficielles des membres inférieurs Presse méd, 1912 XX, 451

QUIET HIP DISEASE

By HENRY LING TAYLOR, M.D., AND WILLIAM IRIDDER, M.D., NEW YORK

FIVE years ago it was noticed by one of the writers that certain hip cases in children ran a very mild course without the usual complications and terminal disabilities of tuberculous hip disease. The trouble usually began from the fifth to the tenth year with a moderate limp often with little or no pain and was associated with characteristic symptoms. A study of 22 such cases shows a definite group in which the cases resemble each other clinically and differ from cases of tuberculo-sis coxa vara and other hip affections.

The onset is usually very insidious, an inconspicuous limp coming on gradually without any known cause. Three of the cases, however, had an acute onset with fever and in two of these there was polyarthritis. In only four of the cases was there a history of

trauma, the limp appearing one three, nine, and twelve months after the injury. Mobility at the hip is often only slightly restricted at first and spasm is absent, but later lateral motion and rotation in flexion, especially abduction and internal rotation, may be much limited and there may be some spasm on attempting to force the motion. The plane of flexion is usually elevated outward, but flexion to nearly 90° and often beyond, is preserved. The mobility resembles that of an early period of osteo-arthritis in the adult.

Pain may be present at some stage of the affection, usually after overactivity and may be in the hip, knee thigh or groin and night cries sometimes occur, but pain is rarely an important or conspicuous symptom. Some patients run their course with scarcely any at all.

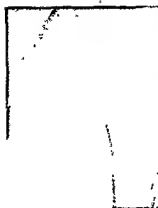


Fig. 1. Case 1, right quiet hip one and a half years' duration



Fig. 2. Terminal condition Case 1, six and a half years after onset



Fig. 3. Case 2, left quiet hip one and a half years' duration

In some of the cases there is no shortening of the affected limb, but in the majority there is a shortening of one-quarter to one half inch, in two cases, there was a lengthening of one-quarter inch. In most of the cases there is moderate atrophy of the limb. In the cases with shortening, the trochanter is elevated, in some it is effaced, in others prominent. Trendelenburg's symptom is present.

These children are, as a rule, in excellent health and are fairly active, they never have toxæmia, abscess, enlarged glands, fixed deformity, ankylosis, serious suffering, or disability. The symptoms have some resemblance to those of coxa vara and to some cases of slipped epiphysis and hemorrhagic osteomyelitis or cysts of the neck of the femur, but they are easily distinguished by the roentgenogram which shows a thin, flattened epiphysis which may appear to be divided into separate pieces and which as the affection progresses spreads or creeps over the top of the neck toward the trochanter. The epiphyseal line is irregular and broader than normal especially at its upper part and the acetabulum often appears irregular. When the case is moderately advanced the neck is short and thick but there is no notable amount of coxa vara. In some cases there are clear spots near the epiphyseal line. There is no hyperostosis nor apparently any real erosion though there may be exten-

sive flattening or crushing and possibly inhibition of bone formation. These appearances are quite different from those of any other hip affection. The cloudy or foggy appearance and marked local bone atrophy, an early symptom in tuberculosis are absent, though there may be some bone atrophy of the limb from disuse.

The affection lasts from one to three years and terminates in recovery with a remodeled joint but with excellent use. The articular surface of the femoral head is extended toward the trochanter and is somewhat flat but becomes smooth, and there remains a considerable amount of free motion. The lumping and pain if present disappear and only the slight restriction of motion and the changes shown by the roentgenogram remain to identify the process. Ankylosis, fixed flexion or adduction which are so common after hip tuberculosis do not occur.

In our 22 cases the age of onset varied from four to sixteen, six were girls and sixteen were boys, in fifteen cases the right in six cases the left and in one case both hips were affected. In two or three others the roentgenogram showed some thickening of the neck on the well side but there were no symptoms. None of the nine cases in which the Wassermann test was applied gave a positive reaction. Two cases were tested with tuberculin, both were negative. Many of the cases had been treated for longer or



Fig. 4. Case 3, right quiet hip, ten and a half years after onset



Fig. 5. Case 4, right quiet hip, ten years after onset

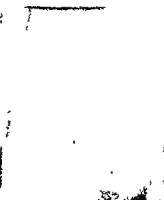


Fig. 6. Case 5, right quiet hip, one and a half years after onset

shorter periods with the short plaster spica, which usually relieved pain, others had crutches or traction in bed, several had been treated for rheumatism or had had no treatment. The tendency is to overtreatment on an erroneous diagnosis of tuberculosis of the hip. Most of the cases that received little or no mechanical treatment did well. It is well, however, to apply a short spica for short periods if pain is troublesome or persistent and to suspend the limb by the use of crutches if deformation of the head is progressing rapidly; activity should be moderately restricted. Traction braces operations and long periods of recumbency are unnecessary, if not detrimental.

The writers believe that this affection is a definite clinical entity which it is important to separate from tuberculosis, syphilis, coxa vara, and some of the rarer hip affections. It is evidently not very rare and its inclusion with cases of hip tuberculosis must have seriously distorted the symptomatology and statistics of that disease, especially as to the results of treatment.

Quiet hip disease in childhood is unquestionably one source of the affection known as osteoarthritis of the hip in adults. One such case (Case 6) is reported in our case histories.

Some of the mild and obscure hip cases in children where the diagnosis has been uncertain are cleared up and shown to be quiet

hip disease after careful raying. In order to avoid error, it is necessary to ray all hip joint and borderline cases.

When, after studying our cases, we came to look up the literature, we found it quite extensive. Legg, of Boston, read a paper on "An Obscure Affection of the Hip-Joint," before the American Orthopedic Association, in 1909, in which he reports six cases of quiet hip disease. About the same time, Wablenstrom published a series of cases which he called tuberculosis of the upper part of the neck of the femur; these correspond with the cases here described as quiet hip disease; he found positive tuberculin reactions in his cases but these are so common in children at the ages tested as not to be by any means decisive as to the local process. An excellent paper by Dehltal appeared in the *Journal of the American Orthopedic Association* for April, 1915 and Allison and Moxley, as well as the writers of the present article, read papers at the meeting of the American Orthopedic Association in May, 1915. The German and Scandinavian literature is quite copious, the classic paper being that of Perthes on osteochondritis deformans juvenilis published in 1913. The affection is generally known in Europe as osteochondritis of the hip or Perthes disease. Perthes removed a specimen by an operation and was surprised to find that the head of the femur, though somewhat irregular, was covered with smooth

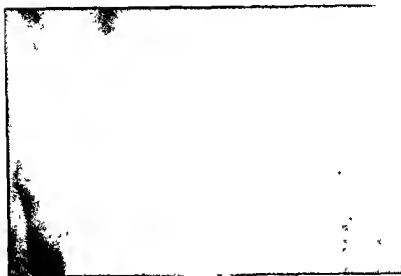


Fig. 7. Case 7 right and left quiet hips, duration of eight a year and a half, of left three months

and normal cartilage, he also found detached and semi detached islands of cartilage near the epiphyseal line which explained the clear spots often seen in the roentgenogram. He found no indications of an infectious process. It is thought by some that the affection is due to disturbed osteogenesis from the blocking of nutrient vessels by trauma or other causes. Delitala believes the underlying cause to be a congenital defect. After all is said, the cause of the affection remains obscure and for this reason the simple name of 'quiet hip disease' based on the general clinical picture is proposed as a provisional title until the pathology is worked out.

Abstracts of the histories of twenty two cases which have been under our personal observation follow. All the cases were rayed and the best examples have been chosen for illustration.

CASE 1 (Taylor) Boy, ~ March 1910 right hip. Acute invasion with severe pain in knee. Slight limp since but well and active. One quarter inch shortening. Motion and roentgenogram characteristic. March 1911, Had short spica about two months. Has been well and active since slight limp, 60° anteroposterior motion. Roentgenograms show terminal stage greatly flattened epiphysis which has crept outward over neck until it touches trochanter. One half inch shortening.

CASE 2 (Taylor) Girl 10 June 1911 left hip moderate limp last ten months. Joint pain in left

knee and now cries in sleep. Trochanter prominent, legs of equal length. Motion and roentgenogram characteristic. Has worn hip splint March, 1912. Has worn short spica since last visit until one month ago. Walks with slight limp. No pain. Roentgenogram shows increase in flattening and spreading of epiphysis.

CASE 3 (Taylor) Girl, 10, May 1912, right hip. Five years ago began to have lameness and some pain in right hip and knee. No mechanical treatment. Now walks with moderate limp, full flexion in deflected plane, rotation and lateral motion limited. Shortening of $\frac{3}{8}$ inch. Roentgenogram characteristic of terminal stage. The photo of the left hip shows a thin globular epiphysis and thick neck, no symptoms.

CASE 4 (Taylor) Boy 9 September 1913 right hip. Slight lameness began two years ago. Traction in bed three months, then up on crutches and short spica. No pain or trouble since. Legs equal length. Motion to 90° with typical limitation. Walk with slight limp. Roentgenogram typical. Left hip appears normal.

CASE 5 (Taylor) Boy 8 February 1913, right hip. Very stout boy. Seized with fever and sudden pains in limbs and muscles a year and a half ago. These passed off, leaving slight lameness in right leg and some dull pain in adductor region. Right leg $\frac{3}{8}$ inch short. Typical motion, 120°. Roentgenogram showed typical changes. No mechanical treatment. April 1915. No pain for a year. Slight limp very active.

CASE 6 (Taylor) Woman 40 January, 1910 left hip. At 14 had slight pain in hip and lameness at times for about a year. No mechanical treatment. No trouble after this until the birth of a



Fig. 8. Case 12, right quiet hip, two years duration, note thin areas in head and neck.



Fig. 9. Case 16, right quiet hip, duration ten months.



Fig. 11. Case 19, left quiet hip, one year's duration.

child ten years ago since when she has had considerable pain about left hip and some lameness, cannot walk far. Left leg is now $\frac{1}{2}$ inch short and abduction is limited. Other movements free. Röntgenogram shows some flattening and mushrooming of head.

CASE 7 (Eiseler). Boy 8 April 1912. Right and left hips. Fell one month ago. No pain. One week ago gradual onset of right limp. Now no limitation of motion in either hip. Röntgenogram shows flattening of head of right femur, left hip negative. July 1913. Short spica last six months. No pain. Shortening or limitation of motion. Röntgenogram shows progress of changes in right head and neck. Left hip shows beginning changes in neck.

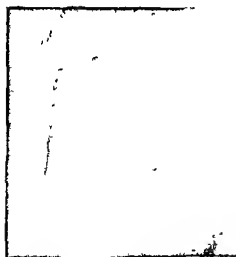


Fig. 10. Case 18, right quiet hip, duration eleven months.

Wassermann and tuberculin negative. October, 1913. Increase of limp and of progressive changes in both hips. No pain or spasm.

CASE 8 (Eiseler). Girl 10 March 1912. Right hip. Gradual onset of limp one month ago. No trauma. No pain. Flexion free. Rotation and abduction markedly limited. No shortening. Röntgenogram shows typical changes.

CASE 9 (Eiseler). Boy, 6 March 1912. Right hip. Onset 18 months ago of lameness with occasional pain in groin. At that time all hip motions free and röntgenogram negative. Limp persists and short spica applied after six weeks. Six months later, röntgenogram showed some flattening of head and roughening along epiphyseal line. All motions slightly restricted. March 1913. Legs equal. Some limitation of lateral motion and flexion. No spasm. Wassermann negative. April 1913. Röntgenogram shows flattening of head, thickening of neck and slight coxa vara.

CASE 10 (Roberts). Boy 6 February 1912. Right hip. Gradual onset of limp without pain a few weeks before. Now $\frac{1}{2}$ inch shortening. Flexion to nearly 90°. Rotation not limited. No spasm. Treatment by brace. Röntgenogram shows progressive flattening and thinning of epiphysis.

The remaining cases were studied at the Hospital for the Ruptured and Crippled in Dr. W. R. Townsend's service except Case 21, which was from Dr. Whitman's service.

CASE 11. Boy 8 November 1911. Left hip. Three months ago fell from wagon. Four weeks ago gradual onset of pain in left knee with limp. Now no spasm or pain. Little motion. Shortening $\frac{1}{4}$ inch. March 1, 1913. Has worn short spica a part of the time until four months ago. No pain. Flexion and extension free. Other motions limited. Legs equal. Trochanter prominent. Slight limp. No complaint. Röntgeno-

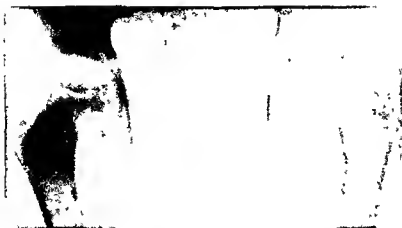


Fig 12 Case 20 right quiet hip duration nine months Compare affected with normal side

gram shows head flat, neck thick, upper side irregular

CASE 12 Boy, 10, May, 1914, right hip Acute polyarthritis two years ago with severe pain All joints recovered except right hip Pain in hip and limping at times only Now flexion free slight limitation of rotation and lateral motion Right leg $\frac{1}{4}$ inch short Rontgenogram shows flattening of head and thickening of neck, also several clear areas in neck March 31 1915 Short spicas till March 21 No pain All motions restricted

CASE 13 Girl 6 $\frac{1}{2}$, August 7 1914 left hip June, 1913 pain in left hip, treated for rheumatism in June, 1914, was lame but had no pain Now all motions free except rotation somewhat limited Rontgenogram showed some thickening of neck and irregularity about epiphysis Short spicas four months March 8 1915 Flexion and extension nearly normal lateral motion good, rotation $\frac{3}{4}$ of normal Left leg $\frac{1}{4}$ inch short

CASE 14 Boy, 12 December 2, 1914 right hip Three months ago gradual onset of pain in right knee Now right limp 100° of free flexion, marked restriction of rotation with some spasm Right leg $\frac{1}{4}$ inch short Rontgenogram shows slight flattening of head neck somewhat thickened

CASE 15 Boy 8, December 14 1914 left hip April, 1913, hit by a wagon nine months later, occasional pain from pelvis to thigh, with constant slight limp Now legs equal flexion free to 75° Lateral motion and rotation limited Short spica about six weeks Rontgenogram shows head slightly flattened neck thickened and irregular April 30 1915 Active slight limp pain at times

CASE 16 Boy 7 January 14 1915 right hip Fell from a wagon eleven months ago and complained of pain in right knee one month later started to limp, no pain Short spica nine months Now $\frac{1}{4}$ inch lengthening right leg All motions markedly restricted Only 5° flexion Rontgenograms

show progressive flattening of head and moderate thickening of neck, some irregularity of epiphyseal line and acetabulum Left neck somewhat thickened April 30 1915 100° of anteroposterior motion No complaint

CASE 17 Girl, 10, March 18, 1915, right hip Pain and lameness right hip six years ago, plaster spica worn No treatment past four years For four months walking with increasing limp, pain in groin Right leg $\frac{3}{4}$ inch short Flexion normal Other motions somewhat limited Rontgenogram shows head very small epiphyses very thin, neck short and thick Left hip normal

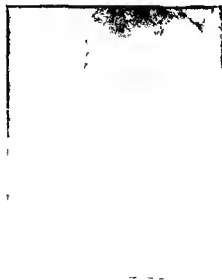


Fig 13 Case 21 right quiet hip two years' duration

PRIMARY BENIGN GROWTHS OF THE STOMACH¹

By SEYMOUR BASCH, M.D., NEW YORK

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THE interest of the profession within recent years has been so centered upon malignant disease of the stomach that little attention has been given to the study of the benign growths that occur in that organ. While the discovery of these latter has in almost all instances been an operative or post mortem surprise, a careful review of some of the reported cases reveals a number of interesting and important facts concerning their occurrence, diagnosis and clinical and pathological significance.

Under the designation of benign tumors there are usually included formations such as phantom tumors, hypertrophic and other thickenings of the pylorus, local inflammation and indurated swellings, aneurisms and diverticuli of the stomach. The present paper however will deal only with the much rarer genuine primary benign growths. These have been but little discussed in the literature and therefore are of far more than usual interest. They include mucous polypi, adenomata, lymphadenomata, myomata, fibromata, lipomata, myxomata, osteomata and cysts.

From the literature it would appear that benign tumors of the stomach are very rare. Jesse Myer (1) mentions that Tilger could find a record of but fourteen in a series of 3,500 autopsies. This is due perhaps to some error in investigation. For Epstein (2) in 1864 found fourteen stomach polyps alone in 600 necropsies. Many of the cases in actual occurrence are undoubtedly overlooked through erroneous diagnosis and lack of opportunity for operative or autopsic investigation.

Benign tumors may originate in any of the layers of the stomach, may remain restricted to the original layer, or may invade any of the other portions of the viscus. They may form flat, rounded, or nodular intramural masses, or project as pedunculated or sessile tumors into the lumen of the stomach or the peritoneal cavity. Sherren (3) records eighteen

cases, the greater number of which were mesoblastic tumors, which projected from the greater and lesser curvatures into the peritoneal cavity, and Orth (4) reports a number of pedunculated lipomata growing from the serosa.

POLYPI

This term is merely descriptive and not histological. The adenomata, fibromata, lipomata, myomata, and papillomata may form polypoid tumors. Sometimes the connective tissue predominates, at other times the glandular elements.

1. *Mucous polypi*. Microscopically, these are composed of the same tissues as the normal mucosa. According to Fenwick (5) they are really small adenomata that have undergone cystic degeneration. Two types are distinguished by Ménétrier (6): a superficial one involving the excretory ducts and associated with much lobulation and many cysts from the connective-tissue obstruction of the duct, and a deeper form involving the glandular portion mainly and showing little or no lobulation and few or no cysts. A mixed type occurs also. Polypi may be single or multiple, the latter may number as many as three hundred. To the multiple form the designation of polyadenomata or polyposis has been given. Single mucous polyps are found most frequently near the pylorus and the multiple in the median portion of the stomach. They form soft, slimy, globular or more or less lobulated, or even cylindrical or mushroom shaped tumors attached to the walls of the organ by a thin stalk or pedicle and varying in size from a wheat grain to several inches in length. A solitary polypus usually measures from one half to four inches, the multiple seldom exceed three quarters of an inch in length, are fairly uniform in size, and have been compared to a bunch of grapes. The color varies with the vascularity from a gray to a deep red brown. The surface is smooth and never adherent.

Reports vary as to the frequency of their

¹ Read at the Fifteenth Annual Meeting of the American Gastro-Enterological Association, Baltimore, May 1915.

9 *Cysts.* Seven varieties of cysts have been noted. The most common are retention cysts met in obstruction of the mouth of the ducts of the gastric glands in chronic gastritis. Other varieties that have been described are dermoid, serous, hydatid, blood, lymphangiomatous or chylous cysts, and those cysts formed through the degeneration of new-growths.

Symptomatology. The clinical picture presented by this group of tumors varies within the widest ranges from complete euphoria and utter unconsciousness of gastric changes to conditions fraught with grave consequences to health and life. This diversity of manifestations depends largely upon the size, location, and nature of the growth. Intramural growths, of small or even quite large size, located at a distance from the pylorus, may give rise to no appreciable symptoms. Large ones are prone to manifest themselves through their mechanical effects, producing a sense of epigastric weight and dragging. Frequently there are present dyspeptic manifestations of various degrees, loss of appetite, loss of body weight, anemia, and even pain. Such large growths are usually palpable through the abdominal parietes.

Where the growth is located in the pyloric region, and especially if it be pedunculated, it is more apt to be associated with active dyspeptic symptoms such as have just been mentioned. Epigastric or hypochondriac pains seem to be one of the most constant manifestations. A frequent tendency of pedunculated growths of all types near the pylorus is to prolapse into this opening and cause a partial or complete obstruction. This gives rise to very violent attacks of pain with nausea, retching, and more or less protracted vomiting. Depending upon the degree of obstruction, there result more or less gastric distention, food retention, gastrosuccorhea and peristaltic rigidity. Frequently there is blood in the vomited matter. The obstruction occurs through a ball valve action and in most cases is only temporary, the tumor falling back into the stomach and a longer or shorter period of quiescence ensues, to be interrupted again by other attacks of acute obstruction, until finally death or operative

interference intervenes. The acute obstructive attack is often the first active manifestation of the disease. Cleghorn (19) reports the occurrence of a pyloric perforation during an attack. This is very rare. More frequent is intussusception. The stomach may be intussuscepted into the duodenum, as in a case recorded by Collier (20), or even the duodenum and part of the stomach into the jejunum, as in Wade's (21) unique case. The tumor in Wade's case was a non pedunculated fibromyoma near the pylorus.

When the tumor involves the mucous membrane, hemorrhage is a frequent symptom. It is due to excessive vascularity of the growth or the surrounding mucosa, or to the erosion of a vessel by ulceration or sloughing. The blood may be visible or occult in the stomach contents or stools. As a rule, even though profuse, the hemorrhage is without serious consequences. Launers and Klemmle (22) have reported cases in which it proved fatal.

The evidence afforded by the thread test will depend upon the presence or absence of surface oozing, ulceration, or free hemorrhage. The same remark applies to the demonstration of occult blood in the stools.

It is difficult to formulate rules of diagnosis regarding stomach content examinations aside from the period of acute obstruction. The majority of case reports include no data on this subject. From the few recorded cases and theoretical considerations, we may safely conclude that where the mucous membrane is not involved and there is no obstruction from the growth, normal conditions of motility and secretion should prevail. Where, however, the growth is one essentially of the mucous membrane, as in mucous polyps of the multiple as well as of the single types, achylia has been reported (Myer, 1; Wegele, 23; Chosrojev, 24, and Campbell, 25). In one of our own patients this was also the case. Myer points out that the achylia is not an ordinary simple one, but is associated with excessive production of mucus of a peculiar character, viz, like egg-white, such as might be expected with great multiplicity of goblet cells. Such a finding, he believes, should always arouse suspicion of a polyposis.

The diagnosis in several cases has been rendered possible by finding a tumor fragment in the vomitus, wash water, or feces

The recent rapid development of *radiological* diagnosis, particularly the direct demonstration of anatomical conditions in the stomach, promises to be of more value in the diagnosis of these tumors than any other means short of the actual demonstration of the growth itself. The following three cases illustrate this point:

CASE 1. D L, male 73, seen in 1912 with Dr Max Dantes, suffered for six months from frequent typical acute gall stone colics each followed by more or less distinct jaundice. X ray examination showed the presence of a persistent large, smooth notch on the greater curvature of the stomach. From this the radiographer concluded that a tumor of that organ was present. The patient who was in active vigorous health, had absolutely no symptoms referable to the stomach other than the nausea or vomiting incidental to his colic attacks. Subsequent operation by Dr A A Berg revealed a gall bladder filled with stones and also a papillary adenoma the size of a walnut, attached to the lesser curvature near the pylorus. The tumor was successfully removed.

CASE 2. W J M, male, 45, entered the Newark General Hospital in January 1915. He had progressively lost in weight and had some indefinite gastric symptoms which might however have been attributed to a chronic nephritis from which he suffered. He gave a history of syphilis and had a two-plus Wassermann. A definite movable tumor mass could be made out in the epigastrium. The X ray examination (see Fig 1) showed that the mass was located within the stomach there being a very large, almost circular filling defect at the junction of the antrum pylori and pars media. The defect was characterized by the same mottled appearance that Jesse Myer (1) described in his case of gastric polyadenomatosis viz. as if the bismuth were trickling through and around irregular masses. On opening the abdomen, a pedunculated mass was felt within the stomach not far from the pylorus this was about 1½ inches in diameter and had its base on the anterior wall. Before the stomach could be incised, the patient collapsed and after resuscitation no further attempts were made to remove the growth. Since then he has received several intravenous doses of neosalvarsan and injections of mercury. A recent X ray examination revealed a persistence of the same condition as before, showing no improvement from the specific therapy.

CASE 3. G A, bridgetender male, 45 married, was referred to me for diagnosis by Dr I M Popper,

in January, 1915. He had been losing in weight, strength, and color for two or three months, despite a very good appetite. He gave a history of years of excessive smoking and beer drinking and of insufficient food mastication owing to poor teeth. Syphilitic infection was denied. In previous years he often had attacks of acute indigestion, especially after sour or coarse food. Three or four years ago, almost daily, he suffered from severe cramps in the calves of his legs and from chest attacks like angina pectoris, which ceased after discontinuance of tobacco and alcohol. In December, 1913, he had profuse hemorrhages from the stomach and rectum. Shortly thereafter, he began to have pulling pains, radiating from the umbilicus to the right hypochondrium, especially in bending over his work.

General as well as abdominal examination is negative except for an accentuation of the first heart sound at the apex, a thickening of the radial artery, and a slight rigidity of the upper right rectus. The systolic blood pressure is 165, the diastolic 100. Repeated gastric tests show hypermotility with alkaline contents and a moderate amount of tenacious gastric mucus. The Wolff and Jungk's tests are extremely faint at 1:200. The faeces, both before and after the gastric tests, give very strong occult blood reactions. The Wassermann reaction is negative.

From this history and objective findings it was difficult to arrive at a definite diagnosis. We had here one of those borderline cases suggesting a number of possibilities, such as ulcer, chronic gastritis, carcinoma, cirrhosis, arteriosclerosis, or syphilis.

To aid in the diagnosis fluoroscopic and radiographic examinations of the stomach were made. These showed hyperperistalsis and hypermotility of that organ. In both the erect and prone positions there was a persistent unusual defect in the pyloric antrum, giving the appearance of finger prints or indentations upon the bismuth shadow (see Fig 2). The defect was in the center of the antrum and did not involve either curvature. These radiological findings, together with the clinical factors of the case, led to the diagnosis of a pedunculated tumor within the pyloric antrum, very probably of a benign character and operation was advised. This was at once performed at the Lebanon Hospital by Dr Henry Roth.

Externally the stomach appeared normal, but in the pyloric antrum a pedunculated mass could be readily felt. The stomach was opened through a longitudinal incision and two papillomatous growths—one about 1½ by ¾ of an inch and the other ¾ by ¾ inch—were found on the posterior wall about three inches from the pylorus. They were radically removed and the bases cauterized with the Paquelin. Sections of the smaller growth showed an entirely benign papillo adenoma. A piece of mucosa was removed and upon examination was found to be histologically normal. The patient recovered very quickly although a gastric test two months later showed persistence of the achylia.

¹ For the clinical details and the radiogram of this case, I am indebted to Dr F C Baker of Newark N J to whom my thanks are again expressed.

PROGNOSIS

From a purely histological standpoint, the adenomata, fibromata, and myxomata, because of their close relationship to malignant disease, offer the most serious prognosis. However, it is readily apparent from what has been said here and in other literary contributions to the subject, that, despite the benign histological and clinical character of the other tumors of this group, they not infrequently have brought about conditions that resulted in alarming manifestations and sometimes even, despite active medical and surgical intervention, in the death of the patient.

Treatment Those benign neoplasms that give rise to no symptoms naturally demand no treatment; however, where the diagnosis is established or strongly suspected in other instances, only one procedure is indicated: viz, operative interference and radical removal of the growth. The lamentable inadequacy of internal therapy and the brilliant success of surgical measures have produced a record that speaks convincingly on this point. The suggestion has been made to attempt the gastrosopic removal of those growths not situated in inaccessible portions of the stomach. Aside from the technical difficulties of this procedure, there are several strong objections, namely, the problem of properly controlling the hæmorrhage, the necessity for

the removal or thorough destruction of the base of the growth, and the possibility of overlooking other growths that may be present. Laparotomy is so safe, simple, and satisfactory, when properly safeguarded, as to suggest itself as the only adequate procedure in these cases.

LITERATURE

1. MYER, JESSE Tr. Am. Gastro-Entero Ass., 1913, p. 113, also J. Am. M. Ass., 1915, Nov. 24, p. 1960.
2. EASTEIN Arch. f. Anat. u. Physiol., 1864, p. 64.
3. SHIFFRIN Brit. M. J., 1912, i, 113.
4. OBIT Lehrs d. spec. Pathol. Anatomie, 1887, i, 717.
5. FENWICK, S., and W. S. Cancer and Other Tumors of the Stomach London 1907, p. 301.
6. MÉNÉTRIÉR Arch. de Physiol., 1858, li, 32.
7. ASCHOFF Pathol. Anat., Jena, 1913, p. 759.
8. CHAPUT Bull. Soc. Anat., 1855, p. 534.
9. PITT Tr. Path. Soc. Lond., 1889, xl, 80.
10. LANGE, N. Y. M. J., 1891, p. 534.
11. FERGUSON Cited by Fenwick, loc. cit., p. 304.
12. ASCHOFF Loc. cit., p. 763.
13. ERLACH, VON Zentralbl. f. allg. Pathol. u. path. Anat., 1895, p. 240.
14. EISELSBERG, VON Arch. f. klin. Chir., 1897, lv, 568.
15. KÖNIG Ibid., 1890, p. 755.
16. FENWICK Loc. cit., p. 349.
17. HANSEN, VON Zentralbl. f. allg. Pathol. u. path. Anat., 1895, p. 717.
18. WEBSTER Lond. M. & Phys. J., 1827, ii, 435.
19. CLEGGHORN New Zealand M. J., 1892, p. 55.
20. COLLIER Tr. Lond. Path. Soc., 1896, xlvii, 46.
21. WADE Surg. Gynec. & Obst., 1913, xvi, 184.
22. KLEMMKE Cited by Steiner, Beitr. z. klin. Chir., 1898.
23. WEGELE Cited by Myer, loc. cit.
24. CHOSHOJEFF Ibid.
25. CAMPBELL Surg., Gynec. & Obst., 1915, xx, 66.

THE CAUSE OF CARCINOMA¹

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THIS thesis proposes that cancer is caused by a defensive process of the tissue-cells to a great variety of irritations, and that there is no specific external cause for cancer. In carcinoma there is a displacement of active cells of epithelial origin into the mesoblastic tissues. The cells are not of a mature epithelial type but are embryonal in character and irregular in their development. By reason of their displacement, they cannot attain the normal anatomic perfection and physiologic activity of mature cells. Their entire energy is expended in karyokinesis. Thus karyokinetic energy is developed in the cell as a defensive reaction to the original irritation which, to produce cancer, must also destroy the basement membrane and produce a similar defensive reaction in the connective tissues. In an open wound, whether it be produced rapidly or slowly, we have healing by granulation. The cells of granulation tissue are similar in structure and appearance to embryonal cells. The result of such healing is a scar of imperfectly developed connective tissue covered with epithelium. There is a normal antagonism between cells of mesoblastic origin, and those of epiblastic origin which prevents them from intermingling under the ordinary circumstances of wound healing. If a bit of skin be buried in the subcutaneous tissues it is ordinarily either cast out as a foreign body or destroyed by the action of the phagocytes, or very rarely forms an inclusion cyst which is entirely benign.

To repair a defect caused by a destructive irritant, the tissues produce new cells with all possible rapidity. The defensive reaction to any irritation that falls short of destruction of the cells is an active karyokinesis. The more active this becomes the more nearly the cells approach the embryonal type. The more the normal process of healing is interfered with by a continuance or recurrence of irritation, the more irregular is the mitosis of the cells. This irregularity is a result of

the struggle for existence, in which they fail to produce perfect cells. This is true both of the epithelial and connective-tissue cells. The more nearly they come to the embryonal type the more do they lose their antagonism to each other. If Haeckel's postulate, that the development of the individual typifies the development of the species, is true, then we may, perhaps, be permitted to use the simile that these new cells are heterogenous allies fighting a common enemy. Like such allies in the common defense they lose their antagonism to each other and more readily mingle. The common purpose is defense, and this is to be accomplished by new cells to close the gap and protect the tissues. Under ordinary conditions the granulation tissue forms a bed, across which the new epithelial cells are projected, and the defect is closed without any disarrangement of their relative position. At the surface where they belong they attain a satisfactory degree of normal structure and formation. When such healing is continuously interfered with by off-repeated irritation and that irritation short of destruction is closely balanced with the reparative power of the tissues, then the reproductive power of the cells is enormously increased. We have a readily demonstrable example of this rapid karyokinesis on the part of the leucocytes when an infective attack calls for a greater phagocytic defense. The reproduction of the cells is defensive to the irritation. The greater the demand for defense within certain limits, the more rapid the growth. Under the stress of defense to prolonged irritation the karyokinetic properties of the cells are enormously increased and as this tendency increases they more nearly approach the embryonal type. This is because the chief function of the embryonal cells is growth, and this growth is stimulated in defense to irritation. As the embryonal cells of the epiblast and the mesoblast resemble each other much more closely in form than do the functioning cells of the mature

¹ Read in the Section on Surgery, Seventh Pan American Medical Congress, San Francisco, June 18, 1915.

type, so also in this defensive struggle do they lose their antagonism to each other. They have one common purpose and that is the defense which is accomplished through growth. The energy of the cells is expended in karyokinesis. Repeated interference with the cell growth produces irregular mitosis. The epithelial cell is less differentiated from the new granulation tissue. In this condition the cells mingle and the young epithelial cells become engulfed and lose their proper position on the surface. They thus intermingle with the young cells of mesoblastic origin and the way is opened to them for the infiltration of the surrounding tissues. The environment which makes for a normal development of the cells is lacking. They belong on the surface and cannot in the depths of the tissues attain anatomic perfection and physiologic activity. They retain the excessive karyokinetic tendency of their immediate progenitors and can only grow and reproduce. This tendency, which was at first a defense growth against the irritation which destroyed the basement membrane, now becomes the undoing of the host. In their effort to reach the surface where they belong the young cells with their new born karyokinetic energy, and with the tolerance for the mesoblastic tissues which they have acquired by contact in the embryonal form, in their defense reaction to the original irritation, continue to grow and disseminate without guidance. The young cells infiltrate the tissues in all directions. The connective tissue thus becomes the stroma of cancer. They invade the lymph spaces and pass along to the tributary glands producing lymphatic metastases. They crowd upon each other and so devitalize the tissues that pressure degeneration and ulceration occur and we have the open ulcerated cancer.

Pathologists have searched, but so far in vain, for some common cause of external origin for cancer. It will not be necessary for us to name for you the bacteria and protozoa that from time to time have claimed this place. The filterable virus of certain mouse and chicken tumors is suggestive only of a single irritating substance that provokes a defensive reaction in the tissues. The

growth of nut galls on the oak is only a similar defensive karyokinesis to a chemical irritant injected by the gall fly.

Let us follow the history of some well known types of cancer and see if we can discover a greater probability of a specific external cause than of the tissue defense karyokinesis that we have outlined. This picture is reproduced in smokers' cancer of the mouth, where the long continued effects of creosote and other products of slow combustion, plus other irritants, give first a leucoplakia and later a destructive ulceration which breaks down the basement membrane and gives ingress to the overstimulated epithelial cells that have been reduced to the embryonal type. It is the same in the mouth cancer of the betel nut chewers of Java, who mix lime with the leaves in forming their favorite quid. Here is an irritant of an entirely different type producing the same result. In the lip cancer of pipe smokers we see a combination of traumatic, thermic, and chemical irritations from the pressure of the hot stem plus the irritation of the smoke. In chimney sweep's cancer we have again the irritating effect of creosote and other smoke products as the destructive agent. Now such agents are not favorable to the development of microbial or protozoan enemies to the tissues. They should truly inhibit such invaders. They are all irritants that call for tissue defense by cell multiplication.

In Tibet in the winter the natives wear small charcoal stoves to keep the hands and body warm, much as the women of our country wear fur muffs. Cancer of the abdominal wall is not uncommon among them. The long continued frequently repeated thermic irritation of the abdominal wall in time produces ulceration that finally gives rise to the displacement of the rapidly growing epithelial cells. In their struggle to cover the frequently disturbed base of granulation tissue, they lose their connection with the margin and are submerged in the new cells of mesoblastic origin. Can we in such a cancer reasonably expect to find some specific external cause that might also be operative in cancer of the cervix? We think not. One condition is common to both: a destructive

irritation from widely different agents that sets up a defense reaction in the cells; the one from a dry heat irritation, the other from the irritation of uterine discharges plus frictional irritation of a thin scar over a lacerated structure of complex contour

Our knowledge of the physical effects of radiation as a destructive agent to the tissues of the body is comparatively recent. Unfortunately for the victims who were the early examples of the destructive effects of the roentgen ray, the application was painless. Long exposure with the inefficient primitive apparatus for the purpose of making radiographs was sometimes followed by frightful ulceration of a most destructive character, painful, and slow to heal. In the frequently repeated slighter and, as we know now, unnecessary exposures of the hands of X-ray operators chiefly in examinations with the primitive hand fluoroscope, the early workers produced dermatitis, telangiectasis and keratosis, which were all distinctly defensive reactions to the irritation. When these failed in their defense by reason of the frequent attacks of the destructive force, conditions for the downward migration of growing epithelium were present and cancer resulted. More than a score of X-ray workers have lost their lives and many more have lost fingers or hands from cancer. Surely there can be no other explanation of the etiology of such cancers.

In the senile keratoses of the hands and face which are sometimes followed by superficial epithelioma, may we not have an example of the destructive agency of light? They occur chiefly on parts exposed to light. It is fair to assume that in addition to other irritations incident to exposure the pernicious effect of continued irritation by light radiation is an important factor in their development.

Does the theory of Cohnheim find a place for reasonable application in these radiation cancers? We think not. Certainly we found displaced cells of epiblastic origin in the mesoblast. They are embryonal and irregular in character. It is not more reasonable to conclude that in such situations they have found lodgment in their new location as a result of defensive reaction to the special irritation

than that they were developed from embryonal rests.

In our discussion of the probability of cancer being caused by some specific agent of external origin, let us contrast these radiation cancers with cancer of the stomach. What single external cause might be operative in such widely diverse conditions? It is agreed that in stomach cancer, ulceration can be frequently demonstrated as the base on which cancer forms, not the base of the ulcer, although this part would be most exposed to infection, but the margin where the young cells from both sides of the basement membrane are making their struggle for existence. Let the cause of the ulceration be what it may, of the many that have been proposed, where else in the body have we conditions more subject to repeated irritation than the tissues surrounding a gastric ulcer in the pyloric region? Is it not reasonable to find in this a cause for the great frequency of cancer of the pylorus? We have here both traumatic and chemical irritants: the traumatism of the peristaltic wave in crowding the stomach contents over on ulcerated area, the chemical irritation of the digestive fluids and of toxins of bacteria associated with the ulceration.

When these irritations are overwhelming in their character the tissues are defeated in their defense and a perforated ulcer results. When, however, they are so balanced with repair that defensive action of the tissue cells is enabled to prevent this by an active karyokinesis, we have ideal conditions for the admixture of the rapidly growing cells which the defensive process fosters.

The complex structure of the mammary gland favors the isolation of small portions of gland tissue. The efferent ducts may become occluded either through a chronic mastitis having its origin in a pyogenic infection during lactation, or through the fissures of the nipple that mark the beginning of Paget's disease. Such extensions may also begin with the involutional changes of the climacteric, or those attendant on nutritional disorders, manifested first as cystic breast. In such a state a single trauma may be the active agent in producing the disturbance of the gland structure that is presently followed

by a chronic irritation from retained autogenous secretion that calls forth the defensive karyokinesis of the tissue cells.

Here also the invasion of the mesoblastic tissues may be favored by the direct pressure of the retained secretions.

What other explanation than the effects of chronic irritation producing a defensive reaction in the tissue-cells can there be for the various cancers of the colon and rectum. Their common site is the dependent flexures where fecal accumulation takes place. The cæcum, the middle of the transverse colon, the dependent flexure of the sigmoid, the rectum, are in connection with pressure of irritating contents subject to the primary lesions that favor the defensive cell reaction which leads later to the infiltration of cancer.

These examples it is believed, are sufficient

to illustrate the fact that in tissues widely divergent in location and function a great variety of irritations, traumatic, thermic, radiant, or chemical—and this includes such substances as lime and creosote as well as the toxins of bacteria—may be followed by cancer. This does not argue well for any possible specific external cause. The only condition present in all is a defense reaction on the part of the cells. That defense is first manifest in the production of new cells.

It is only where long continued or repeated irritation destroys the basement membrane and unduly stimulates a defensive karyokinesis, that the adjacent mesoblastic and epiblastic cells lose their antagonism for each other and mingle, that the invasion of the mesoblastic tissues by immature epiblastic cells takes place, and a cancer is formed.

THE ORIGIN OF RETROPERITONEAL CYSTIC TUMORS

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A CONSIDERABLE amount of speculation has been done in an attempt to explain the origin of the so called chyle cysts of the abdomen. Rokltansky, Moynihan (2), and Dowd (1) have each offered theories. Clinical contributions reviewing the literature and reporting new cases of these curious tumors have appeared with relative frequency in the past five years, so that there has accumulated a rather complete discussion of the subject.

It is my purpose to offer an additional suggestion in explanation of the genesis of certain of these cystic tumors. It seems more than probable that the group of abdominal tumors generally classed as chylous cysts do not all have the same origin. The only way we have of determining the nature of a cystic tumor is by a study of its life history, its location, the structure of its wall, and the character of its contents. By these criteria chyle cysts of the abdomen vary so widely that it seems hardly logical to ascribe a common mode of origin.

The cystic tumors whose origin is herein discussed are retroperitoneal in location, are not lined with epithelium, and the fluid content may or may not be chylous in character. Reference to the embryological development of the lymphatic system it seems to me, points the way rather conclusively to a proper understanding of the origin of this group of tumors as well as of the origin of the more frequent cystic tumors in the lateral regions of the neck, known as hydrocele of the neck, or hygroma.

The most recent investigation (3) divides the development of the lymphatic system into two stages. The primary stage consists of the development of a series of isolated lymph sacs, which are clearly derived from the veins, and which later become united by the thoracic duct which connects these sacs with each other. The secondary stage involves the peripheral growth of lymphatic vessels which sprout out from the endothelial lining of these sacs and spread over the body.

The process of development from the

lymph sac to the adult lymph-node is as follows. The lymphatic sacs by a process of bridging or cutting of the lumen by bands of connective tissue are transformed into a plexus of lymphatic capillaries out of which chains of lymph-nodes are evolved. If this development of a particular lymph-node was arrested at a stage when it was still a plexus we would have the basis for the development of a future cyst. It is some abnormality of the first stage of development in these primitive lymphatic sacs that seems to me to offer an explanation of the origin of the retroperitoneal cystic tumors, as well as the hygromata of the neck.

These primitive lymphatic sacs are four in number, the jugular sacs located in the neck, the retroperitoneal sac located in the abdomen opposite the lower dorsal and upper lumbar vertebra, and the posterior sacs located in the pelvis.

The neck hygromata always seem to arise in the vicinity of the carotid sheaths, the exact location of the primitive jugular lymph-sacs. The origin of these tumors has been ascribed to dilated lymph spaces but it seems strange that if such be the origin they do not develop elsewhere. No epithelium appears in the tumor wall and the fluid content is serous or chylous in character.

Likewise the retroperitoneal cystic tumors, of which the report of a case follows, develop at a point corresponding in location to the primitive retroperitoneal lymph-sac. The walls of these tumors are also not lined with epithelium and the contents may be serous or chylous in character.

The close similarity of these two groups of tumors is strongly suggestive of a common origin, and also the fact that they arise at points corresponding to primitive lymph-sacs points strongly to these structures as the genesis of their origin.

A mechanic 48 years old married. Family and past history negative as to present illness.

Present illness. One and a half years ago he noticed a bulging of the abdomen above and to the left of the umbilicus. He was not disabled and continued his work. In March 1911 he consulted a physician who aspirated about two quarts of a milky white fluid. This operation was repeated in June 1911, September 1911, December 1911, and

August 1912. The second, third, and fourth tapings yielded about one and one half gallons of a yellowish fluid which he described as chicken fat in color. In August 1912, when I first saw the patient, he was poorly nourished his complexion was sallow, and he had an expression not unlike that of the "facies ovariana" of the old writers.

There was no edema of the feet or dilatation of abdominal veins. The lungs were clear, heart enlarged to two inches beyond nipple line, and there were present both diastolic and systolic murmurs.

He presented a symmetrical abdominal enlargement extending from lower thorax apertures to symphysis. Palpation revealed a smooth, tightly distended abdominal wall, perfectly symmetrical and slightly tender. The percussion note was universally flat all over the abdomen in any position the patient would take, except in the right flank, and over the epigastrium, at which points it was tympanic.

Operation. The exploration revealed an enormous cystic tumor which filled the entire peritoneal cavity, reaching from the symphysis below to the ribs above. The base of the tumor was found to rest against the posterior abdominal wall, beneath the peritoneum, extending from an inch to the right of the vertebrae to within one inch of the left kidney. The tumor was easily removed and with but a very small amount of hemorrhage.

The post-operative history was uneventful until the twelfth day after the patient had been sitting up in bed when he suddenly began to vomit. He died two days later with symptoms of acute gastric dilatation.

Histologic examination of tumor wall. The structure of the wall of the tumor was fibrous, non-cellular resembling connective tissue. There was no epithelium present on the inner wall. No chemical examination was made, unfortunately, of the contents but it was noted as being of a chocolate brown color.

CONCLUSION

This tumor and cystic hygromata in the neck originate in the same embryological structures, that is the primitive lymphatic sacs. The evidence of this is found in the fact that the histological structure of the wall in tumors of these two groups is similar, neither being lined with epithelium. The physical characteristics would indicate a similarity in their contents, and finally both groups arise at points where there previously existed the primitive lymph sac.

REFERENCES

1. Ann Surg Phila., xxxi
2. Ann Surg Phila. xiv
3. Florence Sabin. Human Embryology by Keibel and Mall.

GUNSHOT WOUNDS OF THE ABDOMINAL CAVITY¹

WITH REPORT OF CASES

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GUNSHOT wounds of the abdominal cavity, whether they penetrate any of the hollow viscera or not, place the individual in danger of his life. Such injuries usually occur in strong and healthy persons, and all cases demand an exploration of the abdominal cavity. I wish to report eighteen cases as follows:

CASE 1. C. D., male, age 21, American, white, was admitted to Mercy Hospital, March 23, 1901. He had received a gunshot wound produced by a revolver of a large caliber.

Condition on admission. Shocked, intermittent pulse of 80, features pinched, tender over abdomen, muscles rigid, peristalsis active. The wound of entrance was located in the back, one half inch above the iliac crest and three inches to the left of the spinal column. The bullet could be palpated under the skin just below the costal margin to the right of the sternal line.

Operation. Laparotomy performed about four hours after injury.

Pathology. There was much blood in the abdominal cavity. There were two perforations in the jejunum, twelve and thirteen inches respectively from the duodenum. The serosa of the jejunum was torn in one place and there was one perforation of the jejunal mesentery. The perforations were closed by silk sutures. The abrasions of the serosa of the bowel were sutured and the opening in the mesentery closed. The blood was removed from the abdominal cavity by sponging. A glass drain was inserted for drainage and the incision closed. The bullet was removed by a separate incision. The patient recovered and was discharged from the hospital April 30, 1901.

CASE 2. J. C., male, age 20, Italian, white, was admitted to Mercy Hospital, March 5, 1903. He had received a gunshot wound produced by a revolver of small caliber.

Condition on admission. General condition fair. Abdomen rigid and tender. The wound of entrance was on the left side of the abdomen near the umbilicus, on a line drawn from the navel to the anterior superior spine. The bullet went through the abdominal wall obliquely to the right.

Operation. Laparotomy was performed about two hours after injury.

Pathology. There was some blood in the abdominal cavity. There were eleven perforations in small intestines. The perforations were closed by silk sutures. The abdominal cavity was sponged

free of blood. A large glass drain was inserted and the incision closed.

There was more or less drainage of the character of blood serum, having the colon odor. During the convalescence an abscess developed in the right inguinal region. This was opened and about one pint of pus evacuated. The bullet was found at the bottom of this cavity. The patient recovered and was discharged May 2, 1903.

CASE 3. J. T., male, age 20, American, white, was admitted to the Mercy Hospital, May 31, 1905. He had received a gunshot wound produced by a revolver.

Condition on admission. General condition fairly good. Pulse 114, some shock. There was some tenderness of the abdomen and rigidity of the abdominal muscles. The wound of entrance was on the right side, just above the border of the ribs, one inch internal to nipple line.

Operation. Laparotomy, time of operation not recorded but was same day as injury.

Pathology. The abdominal cavity contained much blood. A lacerated wound of the quadrate lobe of the liver was found. There was no other injury to abdominal contents. The blood was removed from the abdominal cavity by sponging. The wound of the liver was packed and the incision closed. The patient recovered and was discharged June 27, 1905.

CASE 4. A. L., male, age 35, Polish, white, was admitted to Mercy Hospital, July 4, 1906. He had received a gunshot wound produced by a .32-caliber revolver.

Condition on admission. General condition fair, pulse 90, and of fair volume. The abdomen was rigid in the upper part. There was tenderness in upper part of the abdomen, peristalsis was diminished. The wound of entrance was about two inches to the right of umbilicus.

Operation. Laparotomy performed about seven hours after injury.

Pathology. The omentum had protruded through the bullet wound. An incision was made through the right rectus, and the omentum was cleansed and dropped back into abdominal cavity. No perforations were found. There was a small wound with a hematoma in the mesentery of the small intestine. Considerable brown serous fluid of sweet odor was present in the abdominal cavity. The incision was closed. Streptococci were found in the fluid removed from the abdomen.

Death occurred the next day, July 5, 1906.

CASE 5. J. C., male, age 27, Italian, white, was admitted to Mercy Hospital, February 2, 1907.

¹ Read before the Allegheny County Medical Society May 13, 1915.

had received a gunshot wound of the abdomen produced by a 32 caliber revolver. He was about 10 feet distant from the gun when the accident occurred.

Condition on admission Temperature 100.2°, pulse 112. No evidence of shock. The abdominal muscles were rigid and somewhat tender. Peristalsis was present. The wound of entrance was 1 1/2 inch outside the mid clavicular line, between the sixth and seventh ribs.

Operation. Laparotomy performed four hours after accident.

Pathology There was some clotted blood in the abdominal cavity. There were no perforations of the abdominal contents. The incision was closed with drainage. He recovered and was discharged from the hospital March 6, 1907.

CASE 6 E. G., female, age 22, American, white, was admitted to the Mercy Hospital, September 2, 1907. She had received a gunshot injury produced by a 32 caliber revolver.

Condition on admission Pulse 116, general condition fair. Respirations rapid. The wound of entrance was in the mid-clavicular line, right side, opposite xiphoid cartilage. The bullet had been moved by a small incision in the posterior axillary line, left side, just below angle of scapula. Crepitation could be felt around posterior wound. The abdomen was rigid, tender, and somewhat dull in the flanks.

Operation Laparotomy performed six hours after injury.

Pathology There was a fracture of the sternal end of the seventh rib on the right side. About one half pint of blood was found in the abdominal cavity. The left pleura was opened. No perforations were found nor injury to the liver. The incision was closed and the abdominal cavity drained through Douglas' pouch.

Several days later there was a fecal discharge through the wound where the bullet had been removed. The fecal matter was well digested. This discharge continued for some time. In this case it is evident that the bullet went into the abdominal cavity and out through the diaphragm on the left side, and in its progress went through the splenic flexure of the colon. However, at the time of operation no injury to any hollow viscus could be found. The patient recovered and was discharged October 5, 1907.

CASE 7 Male age 13, American, white, was admitted to the Mercy Hospital, December 4, 1907. He had accidentally been shot while attempting to load a 22-caliber rifle. The bullet entered on the right side of the abdomen taking a course downward and backward.

Condition on admission General condition fair. The abdomen was rigid and tender.

Operation Laparotomy was performed six hours after injury.

Pathology There were two perforations of the sigmoid. These were closed by silk sutures. The

incision was closed with drainage. The patient recovered and was discharged from the hospital December 22, 1907.

CASE 8 M. W., male, age 28, American, white, was admitted to the Mercy Hospital, February 16, 1908. He received a gunshot wound produced by a revolver of large caliber. He was three feet from the gun when the accident occurred. He walked a short distance to a physician's office who immediately brought him to the hospital in a trolley car, a distance of 30 miles.

Condition on admission Pulse 100, abdomen slightly distended. The abdominal muscles were rigid and tender, peristalsis was absent. The wound of entrance was under the left costal margin, above and to the left of the umbilicus in the mid-clavicular line.

Operation Laparotomy performed five hours after injury. Median incision above umbilicus.

Pathology The abdominal cavity contained a large amount of dark blood. There were two perforations of the stomach, one in the anterior wall about two inches from lesser curvature and almost in the center of fundus, the other in posterior wall, slightly lower than in the anterior wall. There were two perforations of the transverse colon, one in anterior wall opposite the mesentery, the other in the posterior wall at the attachment of the mesentery. There was one perforation of the transverse mesocolon. The perforation of the anterior wall of stomach and the anterior wall of transverse colon were closed in the usual manner. The perforation in posterior wall of stomach and the perforation in posterior wall of transverse colon were closed after going through the gastrocolic omentum. All perforations were closed with silk sutures. An opening was made just above the pubes, for drainage. A rubber tube was inserted into the lesser peritoneal cavity and several pieces of gauze to site of perforations. The incision was closed. The patient recovered and was discharged from the hospital March 10, 1908.

CASE 9 S. A., male, young adult, Italian, white, was admitted to Mercy Hospital, September 28, 1908. He received a gunshot wound produced by a 32-caliber revolver. He was six feet away from the gun.

Condition on admission Slight shock. Abdominal muscles rigid. Tender over abdomen. Peristalsis absent. The wound of entrance was in the right semilunar line above level of umbilicus.

Operation Laparotomy was performed about twelve hours after injury. An incision was made through the right rectus.

Pathology Two large perforations were found in the small intestines, middle portion. The openings were opposite one another. There was marked inflammation of the intestines at site of the perforations. The bowel was resected for the reason that to close the openings would have occluded the lumen of the bowel. An end to end anastomosis was done. Sutures were first inserted through all

coats of the bowel over which a continuous Lambert suture was introduced through serosa and muscular layers. The opening in the mesentery was closed. Silk sutures were used throughout. The abdominal incision was closed with drainage.

On November 1, a mass was palpable in the lower left side of abdomen extending two inches above Poupart's ligament. Rectal examination revealed a mass in the pelvis extending up to the left. A rectal speculum inserted and proctotomy performed. Through this opening about one pint of pus escaped. The patient recovered and was discharged from the hospital November 18, 1908.

Case 10. M. V., male, age 38, Italian, white, was admitted to the Mercy Hospital, February 8, 1910. He had received a gunshot wound produced by a revolver.

Condition on admission. Abdominal muscles tender and rigid. Not much peristalsis. The wound of entrance was just above the costal cartilage of the ninth rib on the right side and above the level of the umbilicus.

Operation. Laparotomy was performed the same day of injury.

Pathology. Much fluid present with intestinal contents was present in the abdominal cavity. Two perforations were found in the transverse colon near the hepatic flexure. There was a small wound in the mesentery of the small intestine. The bullet was free in the abdominal cavity. An incision was made through the right semilunar line. The openings in transverse colon were closed by inverting the bowel. The abdominal cavity was cleared by syringing and the incision was closed. Two drainage tubes were inserted, one above pubic bone, and the second in right loin. The patient died February 8, 1910. Autopsy revealed peritonitis to be the cause of death. No other perforations were present.

Case 11. M. D., female, age 21, Italian, white, was admitted to the Gill Hospital, Steubenville, Ohio, under the care of Dr. J. C. M. Floyd July 20, 1910. She had received a gunshot wound produced by a revolver.

Condition at time of operation. Expression good. Pulse 120, slight elevation of temperature. Abdomen distended, slightly rigid all over abdomen and tender to pressure. Peristalsis very poor. The wound of entrance was just above Poupart's ligament, two and one half inches from midline, on right side.

Operation. Laparotomy performed fifty-seven hours after injury. Incision made a little to the right of midline between umbilicus and pubes.

Pathology. Diffuse peritonitis, much pus in right iliac fossa. One perforation of the caecum. The bullet evidently made just one opening. A second incision was made through the semilunar line on the right side and an artificial anus established through the perforation. The caecum could not be brought up to the original incision. The caecum was anastomosed to the peritoneum with silk. A small tube was inserted to the bowel for drainage and the

incision closed. A colostomy was done to establish drainage and a small tube was inserted into Douglas' pouch. The patient made a good recovery from the injury and operation but died August 15, 1910. Dr. Floyd informed me that the abdominal symptoms had at this time entirely cleared up and that the cause of her death was due to sepsis.

Case 12. J. Q., male, age 41, American, negro, was admitted to Mercy Hospital, September 27, 1910. He had received a gunshot wound produced by a revolver.

Condition on admission. General condition poor, muscles of the abdomen rigid and tender to pressure. The wound of entrance was just above the ninth rib, left side.

Operation. Laparotomy performed seven hours after injury. Incision was made in the midline between the umbilicus and pubes.

Pathology. Less and considerable blood in the abdominal cavity. One small opening was found in the transverse mesocolon. Two perforations were found, one in anterior wall of pylorus, the other in posterior wall, directly opposite. The perforatives were large enough to admit the end of a finger. An opening was found in the gastroduodenal omentum from which there was free bleeding. The perforation in the anterior wall of the pylorus was closed. The opening in the transverse mesocolon was enlarged and the perforation in the posterior wall of pylorus closed, silk sutures being used for both. The opening in the transverse mesocolon was closed, leaving, however, a drainage tube in the lesser peritoneal cavity. Drainage was inserted to the anterior wall of the stomach, at the site of perforation. A glass drain was inserted to pelvis and the incision closed. The patient died the same day, evidently from shock.

Case 13. F. M., male, age 12, American, white, admitted to Sewickley Valley Hospital, under the care of Dr. DeWitt R. Nettleton, December 27, 1910. He had received a gunshot wound of the abdomen produced by a 22 caliber Eberhart rifle.

Condition on admission. Much shock, abdomen slightly distended, muscles rigid and tender to pressure. Peristalsis lost. The wound of entrance was just below the border of the ribs, right side, one and one half inches from midline.

Operation. Laparotomy was performed four hours after injury.

Pathology. Large amount of blood was present in abdominal cavity, one quart at least. A good sized blood vessel was found bleeding in the gastroduodenal omentum. I thought at the time this was the hepatic artery but later I concluded that it was a branch. There was a slight abrasion of the surface of the liver where the bullet had passed between the liver and the stomach. The liver was slightly lacerated near its posterior margin. The lesser peritoneal cavity contained blood. No perforations were found.

An incision was made in the midline between the

xiphoid and umbilicus. The bleeding vessel was controlled. The abdominal cavity was sponged free of blood. The laceration of the liver was sutured. A drainage tube was inserted to the pelvis through a small incision just above pubes and the incision closed. The patient made a good recovery.

CASE 14. A J., male, age 29, American, negro, was admitted to Mercy Hospital, March 19, 1912. He had received a gunshot wound produced by a revolver.

Condition on admission. General condition fair but somewhat shocked. The abdominal muscles were rigid and tender to pressure. Peristalsis was absent. The patient also had several incised wounds of the head. The wound of entrance was in the upper left quadrant of the abdomen on a level with the umbilicus.

Operation. Laparotomy was performed eleven hours after injury.

Pathology. In the lower part of the ileum was a ragged laceration, almost completely dividing the bowel, with a tear in the mesentery two inches long. A little higher in the ileum, on opposite sides of the bowel, two perforations were found both large enough to admit the finger end. Between these two points of injury to the bowel the mesentery was badly injured. The appendix had been amputated by the bullet one inch from base. Its mesentery was not injured. There was also a wound of the mesoæcæum two inches long opening up the retro-æcæal space. The abdomen was full of blood.

An incision was made through the left rectus. The blood was removed from the abdominal cavity and the injured bowel searched for and found. On account of the extensive injury to the bowel it was necessary to resect eighteen inches of it. After closing the end of the bowel a lateral anastomosis was done. The perforations higher in the ileum were closed. A lateral anastomosis was performed here also, for the reason that the lumen of the bowel was almost occluded. The remainder of the appendix was removed and the stump inverted. The holes in the mesentery were also closed. A drainage tube was inserted to the pelvis and drainage established to the site of the bullet wound. The incision was then closed. The patient did not react and died the same day as operation.

CASE 15. P. K., male, age 35, American, white, was admitted to the Mercy Hospital, December 11, 1911. He had received a gunshot wound produced by a revolver of a large caliber.

Condition on admission. General condition good. Abdomen rigid, especially in right upper quadrant, with some tenderness in that region. Peristalsis present. The wound of entrance was just below the costal margin on the right side, just below the border of the ribs.

Operation. Laparotomy performed two hours after injury.

Pathology. Abdominal cavity contained a large amount of liquid and clotted blood. The course of the bullet was downward and outward, where it

struck the tenth costal cartilage and fractured it. There was no injury to any abdominal organs.

An incision was made through the right rectus. The blood was removed from the abdominal cavity by sponging, and a thorough examination was made. A drainage tube was inserted through the loin on the left side on a level with the anterior superior spine, and the incision was closed. On January 21, 1912, the bullet was found under the skin in the back, between the ribs and the crest of the ilium. He recovered and was discharged from the hospital January 27, 1912.

CASE 16. H. C., male, age 17, American, white, was admitted to the Mercy Hospital, August 11, 1913. He had received a gunshot wound of the abdomen produced by a .25 caliber revolver.

Condition on admission. Markedly shocked. The abdominal muscles were very rigid and there was tenderness all over abdomen. No peristalsis. The wound of entrance was two or three inches below the crest of the ilium on the right side, the course of the bullet being upward.

Operation. Laparotomy performed about seven hours after accident.

Pathology. The abdominal cavity was full of blood. There were four perforations in the lower part of the jejunum and five perforations in the lower part of the ileum.

An incision was made in the midline. The perforations in the jejunum were closed by silk. The lumen of the bowel was much occluded and a lateral anastomosis done, short circuiting the faecal current. All perforations of the ileum were closed except one. This was brought to the incision and anchored to the peritoneum, forming an artificial anus. Drainage was instituted to pelvis and the remainder of incision closed. The patient developed a severe peritonitis and died August 13, 1913.

CASE 17. Male, age 46, American, white, was admitted to the Markleton Sanatorium, June 11, 1914. He received a gunshot wound of the abdomen produced by a shotgun loaded with about No. 2 shot.

Condition on admission. Bad general condition with much shock. Abdominal muscles very hard with tenderness all over abdomen. Some peristalsis. Wounds of entrance there were seven or eight wounds of the abdomen which entered the abdominal cavity. He received also other wounds of the body, mostly of the legs.

Operation. Laparotomy performed fourteen and one-half hours after injury.

Pathology. Abdominal cavity contained small amount of blood. There were sixteen perforations found in the small intestines. The perforations were below the middle of the jejunum, scattered all along the ileum, to within one foot of the ileo-æcæal valve. The perforations were small. There was some injury to the mesentery of the small bowel.

An incision was made in the midline below the umbilicus. The perforations were found and closed.

The blood in abdominal cavity was removed by sponging and the incision was closed after placing a drain in pelvis. The patient died the next day after operation, evidently from shock and peritonitis.

CASE 18. D. J. S., male, age 40, American, white, was admitted to the Ohio Valley Hospital, Steubenville, Ohio, under the care of Dr. Curtis Laughlin, October 25, 1914. He had received two gunshot wounds produced by a .38 caliber revolver.

Condition on admission. General condition good. Slight shock. Abdominal muscles were very rigid with tenderness all over abdomen. Sore peristalsis. Blood pressure 100. Wound of entrance was a little to the left of umbilicus, the other on a level with the anterior superior spine, midway between the crest of the ilium and iliac, on the right side.

Operation. Laparotomy performed 2 hours and 40 minutes after injury.

Findings. The abdominal cavity contained between one and two pints of blood. There were seven perforations in the wall of the large intestine within three feet of one another. The part of bowel was probably a foot from the ileocecal valve. One of the perforations was three fourths of an inch long. There were two perforations in the mesentery. Two of the perforations were at the mesenteric attachment. The sigmoid in one place was at risk, the abscesses evidently being produced by the bullet. The parietal peritoneum in the right iliac fossa was perforated.

A midline incision was made on the right side, on a level with the umbilicus. The blood was removed from the abdominal cavity by sponging, and a search made for the perforations. The perforations were all closed. The lumen of the bowel was not obstructed at any place. The sigmoid of the sigmoid was inverted. Two drainage tubes were inserted, one just above the pyles in the pelvis the other through the entrance of the uterus in right loin.

During operation 2,000 ccm. normal salt solution was given intravenously. Convalescence was fair but the patient had some complications during this time. Two days after the operation he developed acute distention of the stomach, which was relieved by lavage. The patient also developed symptoms of obstruction, causing a great deal of concern. Fortunately all the symptoms cleared up and he recovered.

The general recovery percentage for the eighteen cases is 61.11. In these eighteen cases only thirteen had perforations of the hollow viscera with seven recoveries, giving a recovery percentage of 53.84. Five cases did not have any injury to any part of the intestines. Of this number four recovered.

The perforations occurred in all parts of the intestinal tract from the stomach to the sigmoid inclusive, except the duodenum.

The greater number of perforations in any one case was sixteen. The time of operation after injury in those cases which recovered was from two to twelve hours. In those cases in which death occurred the time of operation after injury was from seven to fifty seven hours. The average time of operating after injury in those who recovered was about five or six hours; for those who died the average time was about seventeen hours. A definite conclusion cannot be drawn from this series, but I believe that if an operation is performed within the first six hours there would be many more recoveries.

The symptoms of gunshot wounds of the abdominal cavity are quite frank and vary but little in every case. All that is necessary to make a diagnosis is the rigidity of the abdominal muscles, tenderness of the abdomen to pressure, and the wound of entrance. The tenderness is possibly more acute in the region of the wound. There are also other symptoms present such as shock, more or less severe, with its accompanying pallor, increase of pulse rate, vomiting, etc. Peristalsis is also diminished or absent. Distention of the abdomen is usually late. Dullness may be present resulting from hemorrhage. These symptoms are common also to any intraperitoneal perforation of any of the abdominal viscera from disease.

The treatment is entirely operative and should be done early. After opening the abdomen all that is necessary to do in most instances is to close the perforations, remove all blood from the abdominal cavity, introduce drainage and close the incision. It will be necessary occasionally to resect a portion of the bowel for extensive injury to the bowel itself or its mesentery. Lateral or end to end anastomosis can be done. An artificial anus can also be established. This procedure is valuable where the operation is late and peritonitis is advanced. After closing a perforation in the small bowel if it is found that the lumen is too much or entirely occluded an entero-enterostomy can be done. This will avoid a resection and save much time. The opening should be made near to the closed perforation. The best way to close the perforation in my opinion,

is first to appose the edges of the opening by silk sutures which go through all the coats of the bowel and then introduce a continuous Lembert suture of the same material which takes in only the serous and muscular coats. This method makes but little narrowing of the lumen of the bowel.

Many complications follow these injuries. Shock comes first. It immediately follows the accident. Hæmorrhage when it occurs is a close second. Other complications occur. Peritonitis is always present. Threatened obstruction of the bowel and acute dilatation of the stomach should be kept in mind. These complications require appropriate treatment. The hæmorrhage is controlled at the time of operation. The treatment for peritonitis need not be described for it is well known. Threatened obstruction of the bowel deserves much consideration.

Russian oil in good sized doses with enemata given at regular intervals has given good results in my hands. Acute dilatation of the stomach demands immediate attention. The diagnosis should be made early. The signs to be looked for are irritability of the stomach causing regurgitation or slight emesis and the dilatation of the stomach. This should easily be discovered.

In these cases of gunshot wounds of the abdomen I have always noted that the concavity existing normally at the intercostal angle has disappeared and is replaced by a fullness or convexity when acute dilatation of the stomach develops. If this condition is left untreated it will go from bad to worse. Lavage is the treatment. Two or three washings of the stomach may entirely relieve the complication but treatment must be instituted early to get this result.

THE PHYSIOLOGICAL METHOD OF TENDON TRANSPLANTATION¹

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I. HISTORICAL; ANATOMY AND PHYSIOLOGY OF TENDONS

I REFER here not to the free transplanting of a tendon but to the transference of its point of insertion in such a way as to alter the function of a muscle. A rational system of tendon transplantation must be based upon an accurate knowledge of the anatomy and physiology of tendons and muscles. That our present systems are empiric rather than rational is shown by the marked discrepancy in the operative methods of prominent orthopedic surgeons. Thus Lange², on the basis of over 2,000 tendon operations, is radically opposed to Vulpius whose experience is almost as great. Lange insists upon the periosteal implantation of the transplanted tendon first advocated by Drobnik, and lengthens the tendon artificially by silk strands. Vulpius maintains the advantages of sewing the transplanted tendon to the paralyzed tendon, the method first advocated in 1882 by Nikoladoni. Lange sutures the tendon under the greatest possible tension, Vulpius under moderate tension, Stoffel without any tension whatever. Lange draws the tendon through the fatty subcutaneous tissues, Vulpius beneath the fascia. The discrepancies in the after-treatment are equally marked. Thus Lange advocates six weeks' fixation, whereas Putti begins to exercise the transplanted tendon several days after the operation.

These divergent views do not concern inconsequential details but the essentials of the operation. It is evident that a tendon transplantation differs radically from a finished surgical procedure, such as a gastro enterostomy; in the latter, despite slight differences of method, all surgeons are agreed as to the essentials, whereas in the tendon transplantation scarcely a single principle in the operative procedure can go unchallenged.

In these papers I wish to report the result of studies in the anatomy and physiology of

tendons, conducted during the past 2 years in the experimental department of the Oskar Helene Home for Crippled Children, Berlin, and to suggest a series of tendon operations based upon these studies. The essential principle of many of these operations was published in 1910 by Professor Biesalski, the director of the hospital, and it was with his co-operation that the final operative technique has been formulated. I am deeply indebted to Professor Biesalski for his encouragement and for the opportunity to test clinically the practical effectiveness of the operations. The anatomical dissections and the animal experiments were performed in the Pathological Department of the municipal Urban Hospital, Berlin, whose director, Dr. M. Koch, freely placed all the facilities of his department at my disposal.

THE HISTORY AND PLAN OF THE RESEARCH

These studies had their inception during the winter of 1912. Professor Lange of Munich, in whose clinic I was then serving, finding that the results of many tendon transplantations were impaired by post-operative adhesions, urged the need of experimental work to determine the method of preventing these adhesions. I assisted Dr. Henze, of New Haven, in the attempt to solve this problem. We tested successively the effect of ensheathing the tendon operated upon, with fat, fascia, veins, cartilage, vaseline, thin tubes of rolled silver, and Cargile membrane. In all instances except with the Cargile membrane the adhesions proved firmer than where nothing was inserted to prevent their formation. The Cargile membrane, though giving better results than the other substances, did not act effectively to prevent adhesions.

An excellent means, however, proved to be the technique employed by Biesalski: the utilization of the sheath of the paralyzed tendon as a simple physiological means of

¹ See bibliography at end of third paper.

² This article is the first in a series of papers on "Tendon Transplantation." The other two articles will appear in subsequent issues.



Fig. 1. Microscopical longitudinal section through the upper pole of the sheath of the flexor longus hallucis (adult). Van Gieson stain. Ietz obj 5, oc. 4, tube 140. S. L. Synovial layer, C. T. vascular connective tissue. The section shows the microscopical characteristics of the wall of the sheath: (1) the thin synovial lining consisting of a single layer of cells irregularly distributed, in a finely fibrillar almost homogeneous matrix, which, with "Van Gieson" is stained violet, (2) the subjacent coarsely fibrillar vascular connective tissue layer, which above the sheath is continuous with the paratenon of the tendon.

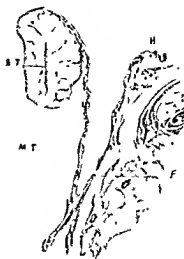


Fig. 2. Microscopical cross section of the tendon of the tibialis anticus (8 months infant) 0.5 cm. above the intermalleolar line. Ietz obj 1, oc. 0, tube 140. Previous to fixation, the sheath had been slit open, the tendon lifted out so as to stretch the mesotenon and was held in this position during fixation. The section demonstrates the relation between the tendon hilus, mesotenon, and floor of the sheath. FT Endotenon, MT mesotenon, F floor of the sheath, H hilus of the tendon.

avoiding adhesions. The paralyzed tendon is withdrawn from the sheath, the transplanted tendon drawn through the sheath in its place. Our animal experiments proved conclusively the correctness of Biesalski's clinical observations, in six instances of tendon suture and in three of tendon transplantation, examination of specimens removed 4 to 30 days after operation showed the complete absence of adhesions.

This clear cut experimental evidence in favor of the principle of Biesalski's operation indicated the advisability of thoroughly investigating its potentialities and perfecting its technique. In his procedure I saw not merely a means of preventing adhesions, but a principle of radical importance: that of adopting the operation to the normal anatomy and physiology of tendons. Every detail of the operation should be made consistent with the anatomical and physiological facts. The method of fixing the tendon, the degree of tension given it, the line of traction—all should conform to the normal. It became evident, however, as soon as I tried to follow out this line of thought that our conception of the normal is still hazy.

The physiology of tendon motion, traction, and tension has never been investigated. I found that we had been talking glibly about the gliding of a tendon without any accurate conception of how a tendon glides,

about the tension of a tendon without any conception of how great the tension normally is. Even the anatomical facts were, I found, not sharply defined. The conceptions of the tendon sheath, the relation between the peritenon and the sheath, between mesotenon and peritenon, the vascular supply of tendons and many of the details of the finer anatomy of tendons and their related structures were loose and vague. It was therefore necessary, before attempting to formulate an operative technique, that these basic facts be investigated.

The plan of study resolved itself into four main divisions:

I. The general conceptions of tendon anatomy and physiology with the following sub-headings:

1. The relation of the tendon to its sheath, the fascia, and the surrounding loose connective tissues.
2. The blood supply of tendons.
3. The mechanism of the gliding of tendons.



Fig. 3. Microscopical cross section through the hilus of the extensor longus hallucis tendon (adult). *TC* hilus of 1, tube 140. *TC* Tendon cells. *ET* endotenon. *EP* epitenon. *MT* mesotenon.

The mesotenon expands at its insertion into the tendon, forming a delicate tightly adherent connective tissue enveloping layer—the epitenon. From the epitenon connective tissue septa extend into the tendon, separating it into larger and smaller bundles. These septa I have termed the endotenon (old terminology: peritenonum internum), as opposed to the exotenon the connective tissue coating the surface of the tendon. Within the sheath the exotenon is represented by the epitenon and the mesotenon above the sheath and at the two portals of the sheath by the paratenon.

4. The tension of tendons

II. The anatomy and physiology of each individual tendon

III. The application of these facts to the technique of tendon transplantations

IV. The experimental and clinical results

I. GENERAL CONCEPTIONS OF TENDON ANATOMY AND PHYSIOLOGY

1. The tendon sheath and the connective tissue structures associated with the tendon

The term tendon sheath is frequently loosely applied. The surgeon often speaks of a sheath of the Achilles tendon or of the semi tendinosus tendon, although no true sheath is present. The sheath properly conceived corresponds to a joint in that it is a sharply circumscribed cavity containing a synovial-like fluid. It is found whenever a tendon at some phase of its motion is forced to turn a corner. When a tendon pursues a straight



Fig. 4. Photograph of the extensor proprius hallucis tendon of an adult. The sheath has been opened, the fascia above and below incised and the tendon lifted out of its bed. *1*, The lowermost muscle fibers; *B*, the upper limit of the sheath; *C*, the mesotenon stretched to the maximum width a cm. *D*, lower pole of the sheath.

course, no sheath is found. Sometimes when a tendon changes its direction, no sheath is present, as in the instance of the quadriceps and patella tendons. Here, however, the knee joint takes the place of the sheath. The object of the sheath is evidently to act as a fluid buffer where the tendon rubs against bone or ligament. It does not give the tendon an increased range of motion, since the tendon glides as freely above the sheath as within it. A tendon sheath differs from a bursa only in its degree of development; therefore the line of differentiation between the two is difficult to determine. The sheath, when fully developed, completely encloses the tendon; the bursa protects a relatively small portion of the circumference of the tendon. Many sheaths, however, fall far short of completely enclosing the tendons; e.g. that of the peroneus tertius, whereas some bursa, as that of the flexor carpi radialis, line more than half the circumference of the tendon.

Retterer, the French embryologist, claims that the sheath is not a sharply defined structure; that it is not closed at its ends, but merges with the connective tissue, of



Fig. 5 The tendon of the tibialis posticus after injecting the vessels with gelatin cinnabar. The tendon has been lifted out of the sheath so as to demonstrate the proximal and distal vincula and the anastomosing blood vessels which ramify on the deep surface of the tendon. This tendon is regularly without a mesotenon.

which it is but a differentiated part. My injection experiments and microscopical sections bring me to an opposite conclusion. They show clearly that with rare exceptions, the sheath is closed at both ends by a very thin, definite lining membrane. This membrane is easily ruptured when fluid is injected into the sheath under pressure and when infection has occurred within the sheath it cannot offer any barrier to its spread.

The wall of the sheath corresponding to that of a joint is lined with a layer of cells which we may term synovial. They are probably modified connective tissue cells developed from the undifferentiated embryonal connective tissue, which surrounds the foetal tendon. The usual fixation methods cause the cell protoplasm to shrink so that in microscopical sections (Fig. 1) one sees only irregularly shaped and irregularly placed nuclei lying in a finely fibrillar almost homogeneous matrix which with the Van Gieson stain is sharply differentiated from the coarser fibers of the subjacent, very vascular connective tissue. The synovial layer is, however, not a complete lining of the sheath. Just as the hyaline cartilage of the joint is not everywhere coated with a synovial layer

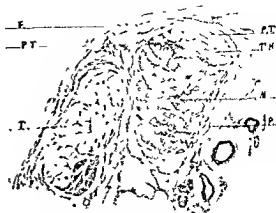


Fig. 6 Microscopical cross-section through the tendons of the extensor proprius hallucis and extensor longus digitorum (6 months infant) 1.5 cm above the intermalleolar line. Leitz obj. 1 oc. 1, tube 140. F Fascia, PT paratenon, T tendons of the extensor longus digitorum, TH tendon extensor proprius hallucis, M muscle, P perimysium.

The section shows the tendons above the upper pole of their sheaths where they are enveloped by loose, fatty connective tissue—the paratenon. The paratenon is continuous with the perimysium and adventitia of the blood vessels. It fills out all the crevices of the fascial compartment, and by means of its elasticity allows the tendon to move freely.

(Fick, *Anatomic der Gelenke*), so in some portions of the sheath I could find no evidence of a synovial lining. The synovial layer may be firmly adherent to the outer fibrous layer of the wall of the sheath, or between the two may be interposed fatty areolar tissue.

The mesotenon. When the sheath of a tendon is opened and the tendon lifted out, a delicate connective tissue membrane is seen connecting the tendon with the floor of the sheath. This structure, known as the mesotenon, transmits blood vessels to the tendon and corresponds roughly to the mesentery of the intestine (Fig. 2). That portion of the tendon into which it is inserted is termed the *hilus*. It is always on the surface of the tendon least exposed to friction. Here the connective tissue of the mesotenon expands on the surface of the tendon forming the *epitenon*, and sends connective tissue strands between the tendon bundles, thus forming the *endotenon* (Fig. 3). When

* Old terminology: peritenon, internum.



Fig 7 Microscopical cross section through the tendon of the extensor proprius hallucis (6 months infant) 1.0 cm above the intermalleolar line. Leitz obj 1, oc 1, tube 140. P Perimysium, F fascia, P.T. paratenon (plica), S tendon sheath, T tendon, M muscle.

The section is taken through the upper pole of the sheath, seen here as a cleft between the fascia and the paratenon. This tendon, therefore, on entering the sheath is not suddenly divested of its loose connective tissue envelope. This accompanies the tendon for a variable distance within the sheath and forms the plica.

stretched to the maximum, the mesotenon of the extensor proprius hallucis tendon is 3 to 4 cm wide at the level of the malleolus

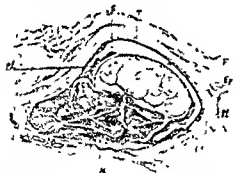


Fig 9 Microscopical cross section through the tendon of the extensor proprius hallucis (6 months infant) at the level of the intermalleolar line. Leitz obj 1, oc 1, tube 160. P Lateral prolongation of the plica S tendon sheath, T tendon, F fascia, Ep epitenon, M muscle.

Here the tendon lies free within the sheaths. The plica is still visible as a fold on each side of the tendon these form its lateral prolongations (Figs 11 and 12) by means of which it is inserted into the mesotenon.



Fig 8 Microscopical cross section through the tendon of the extensor proprius hallucis (6 months infant) 0.5 cm above the intermalleolar line. Leitz obj 1, oc 1, tube 160. P Perimysium, F fascia, S superficial pocket of the sheath, M plica, S' deep pocket of the sheath M muscle, T tendon.

The cleft representing the sheath is seen to be divided into a superficial and a deep compartment by a connective tissue partition. Serial sections as well as the corresponding longitudinal section show this to be continuous with the paratenon of Fig 7. The formation of two compartments is due to the doubling of the plica on itself (therefore the term plica duplicata) whereby it forms a tongue-like projection into the sheath.

(Fig 4) Nearer the insertion of the tendon its width rapidly diminishes for reasons which will be discussed when we consider the mechanism of the gliding of a tendon. The mesotenon is continuous with the connective tissue surrounding the tendon above and below the sheath. When the tendon is al-



Fig 10 Microscopical longitudinal section through the tendon of the extensor proprius hallucis (adult) at its entrance into the sheath. Magnification X 10. P.T. Paratenon, F fascia, S deep pocket of the sheath, P plica, S superficial pocket of the sheath, M muscle, T tendon, M.T. mesotenon.

This section enables us to correlate the preceding cross sections (Figs 6, 7, 8, and 9). The paratenon, the loose connective tissue between the tendon and the fascia, above the sheath forms a tongue like projection into the sheath, which is thus divided at its upper pole into a deep and a superficial pocket. The rôle of the plica in the mechanics of tendon motion is discussed under the "Physiology of Tendons."



Fig. 11. Dissection of the upper pole of the sheath of the tibialis anticus (adult), anterior view. F Fascia, P plicia, P' lateral prolongation of the plicia, T tendon free in the sheath, U upper limit of the superficial pocket, U' upper limit of the deep pocket.

The fascial wall of the sheath has been incised until the superficial pocket of the upper pole of the sheath has been fully exposed. The plicia is thus laid bare. The deep pocket of the sheath between plicia and tendon is indicated by folds of the plicia. The lateral prolongations of the plicia shown microscopically in cross section (Fig. 9) are here seen macroscopically.



Fig. 12. Dissection of the upper pole of the sheath of the tibialis anticus (adult), lateral view. P Distal margin of the plicia, T tendon, M T mesotenon, T incised fascia, P' lateral prolongation of the plicia.

The specimen demonstrates the lateral prolongations of the plicia and their insertion into the mesotenon. Compare with Figs. 9 and 10.

The paratenon. When a tendon is examined above the level of the sheath it is seen to be surrounded by fatty areolar tissue, which completely fills all the interstices of the fascial compartment, in which the tendon is situated (Fig. 6). This areolar tissue is continuous with the perimysium, the perineurium, and the adventitia of the blood-vessels. It is of paramount importance, as we shall see later, in the gliding of the tendon, for, like the mesotenon, its elasticity enables it to stretch several centimeters without tearing its attachment to the tendon. For this connective tissue, usually known as the peritenon externum, I suggest the term paratenon, so as to distinguish it from the connective tissue coating the tendon within the sheath, for which the term epitenon is proposed. Epitenon and paratenon constitute the esotenon as opposed to the endotenon (usually termed the peritenon internum), the connective tissue separating the tendon bundles. For all the connective-tissue structures associated with the tendon, the old term peritenon may well be employed.

The exact mode of entrance of a tendon into its sheath is of importance in understanding the mechanism of tendon motion. Not all tendons behave in the same way. Hartmann was the first to note that some tendons are enclosed by a connective-tissue envelop for some distance within the sheaths, whereas others are without such a connective-tissue covering. Hartmann's observations, though macroscopically correct, are not accurate

lowed to drop back into place the mesotenon adapts itself to its narrow quarters by forming numerous folds, which cover the floor of the sheath. The mesotenon differs radically in one respect from the mesentery: it may be absent. Thus the tendon of the tibialis posticus is always without a mesotenon; the flexor longus hallucis tendon in 70 per cent of the specimens examined, the flexor longus digitorum tendon in 50 per cent. When the mesotenon is absent, it is represented at each end of the sheath by a short membrane which, depending upon its shape, may be termed a trunculum triangulare or quadrangulare. Usually in addition to these vincula there are one or more fine strands connecting the tendon with the sheath, vincula filiformia. These residual mesotena are usually coupled to one another on the surface of the tendon corresponding to the hilus by a thin band of connective tissue in which the blood vessels ramify (Fig. 5).



Fig. 13. Microscopical longitudinal section of the tendon and the plica through the deep pocket of the sheath of the extensor proprius hallucis (adult). For orientation (see Fig. 16) Leitz obj. 3 tube 170. *F*, blood vessels; *S*, *L*, synovial layer; *P*, plica; *S*, deep pocket of the sheath; *F*, epitenon; *T*, tendon.

The plica consists of a vascular connective tissue core and an external synovial layer, which is, however, not always present (see Fig. 15). At the point of reflection to the tendon, the external layer of the plica is prolonged downward on the surface of the tendon as the epitenon.

when microscopically controlled, for then it is evident that every tendon, without exception, on entering the sheath is enveloped by connective tissue. Only in the case of some tendons this tissue is better developed



Fig. 15. Microscopical cross-section through the tendon, plica, and fascial wall of the sheath of the extensor proprius hallucis (6 months infant) 0.5 cm. above the intermetatarsal line. (The same specimen as in Fig. 8 more highly magnified; Leitz obj. 3 oc. 1, tube 160. *F*, fascia; *S*, superficial pocket of the sheath; *P*, plica; *T*, tendon; *L*, irregular surface of the plica; synovial cells absent; *S*, deep pocket of the sheath.

The synovial layer of the plica is not a well developed histological entity, since it is frequently, as in this section, absent.

and is doubled on itself to form a fold—the plica.

The entrance of a tendon into the sheath is best understood by studying a series of microscopical cross sections taken about one-fourth inches apart through the extensor proprius hallucis and correlating them with the corresponding longitudinal sections. In Fig. 7 it is evident that the cleft representing the proximal pocket of the sheath lies not between tendon and fascia, but between the connective tissue covering the tendon, that is the paratenon and the fascia, in other words the tendon is covered by connective tissue in the proximal portion of the sheath. The second serial section, Fig. 8, shows two clefts separated by a connective tissue partition, the plica, while in the third (Fig. 9) the connective tissue has disappeared and the tendon lies free in the sheath. The corresponding longitudinal section (Fig. 10) gives us a clearer conception of the somewhat complicated relations. There we see that this connective tissue, the plica, is continuous with the paratenon and forms a tongue-like projection into the sheath, at the upper pole adherent to the tendon, further distal separated from the tendon by a pocket of the sheath. Thus the proximal portion of the sheath is divided into two



Fig. 14. Microscopical longitudinal section of the fascia, paratenon and tendon through the superficial pocket of the sheath of the extensor proprius hallucis (adult). For orientation see Fig. 16. Leitz obj. 3 oc. 1, tube 170. *S*, *L*, synovial layer; *P*, *T*, paratenon; *F*, fascia; *S*, superficial pocket of the sheath; *P*, plica adherent to the tendon; *T*, tendon.

The vascular partition situated between fascia and tendon above the sheath is prolonged downward into the sheath as the plica. The plica therefore naturally has the microscopical and physiological characteristics of the paratenon, and is like the paratenon peculiarly adapted to the sliding of the tendon. The synovial lining of the fascial wall of the sheath is reflected to the surface of the plica.

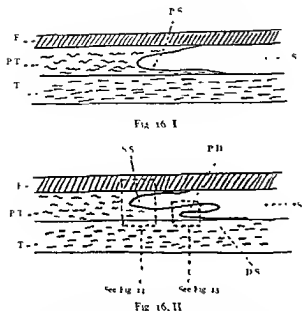


Fig. 16, II

Fig. 16 Diagrams, explaining the difference between (I) the plica simplex and (II) the plica duplicata. P.S. Plica simplex, S sheath, F fascia, P.T. paratenon, T tendon. S.S. superficial pocket of the sheath, P.D. plica duplicata, D.S. deep pocket of the sheath.

Both are prolongations of the paratenon into the sheath. The plica duplicata is doubled on itself so as to form a tongue-like projection; the plica simplex is a simple reflection. The dotted rectangles indicate the topography of microscopical sections Figs. 13 and 14.

pockets, a superficial and a deep. Macroscopically, the structure is easily demonstrated as a thin membrane enveloping the tendons of the tibialis anticus (see Figs. 11 and 12) extensor proprius hallucis and extensor longus digitorum. The tibialis posterior and flexor longus digitorum tendons may or may not show the fold; the flexor longus hallucis rarely does. The peroneal tendons are separated from one another in the upper part of their sheaths by an analogous structure. This fold was termed the plica semilunaris by Hartmann. Its shape is more that of a sickle; however, so the term plica falci formis would be more applicable. As the shape varies from tendon to tendon, it would be wiser to emphasize the constant characteristic of the reflection — the peculiar doubling over itself — by terming it the *plica duplicata*. This term also serves to contrast it with another type of plica, the plica

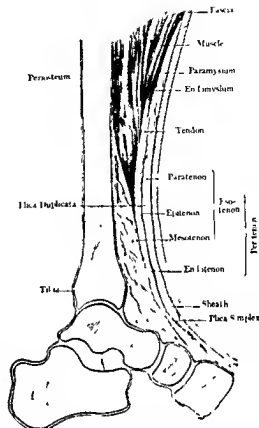


Fig. 17 Ideal longitudinal section through the tendon of the tibialis anticus tendon and the adjacent structures. See text for description.

simplex, in which no such duplicature is present.

Viewed microscopically, the plica duplicata consists of a very vascular loose connective tissue core coated by a layer continuous with the synovial lining of the sheath (Fig. 13). At the two points of reflection of the plica, the upper pole of the superficial and deep pockets of the sheaths, this layer is also synovial in character (Fig. 13 and 14). The synovial cells distally, however, do not form a continuous lining. Frequently, as in Fig. 15, they are not demonstrable and the surface of the plica is irregular in contour and consists of very fine connective tissue fibers.

The second type of plica, the plica simplex, is a fold of connective tissue lined with synovial cells forming the boundary of the



Fig. 18. Microscopical cross section through the tendon of the flexor digitorum profundus (8 months infant). The vessels were injected previous to fixation with a suspension of Turnbull's blue in glycerin. Leitz obj. 1 oc. 2 tube 250. *M.T.* Mesotenon. *H* sheath. *T* Friction surface. *H* hilus of the tendon with longitudinal vessels cut transversely.

The mesotenon lies in folds on the floor of the sheath. The longitudinal vessels of the mesotenon and of the hilus of the tendon are cut transversely. The smaller anastomotic vessels of the tendon running transversely or in a slanting direction are shown in longitudinal section.

upper and lower poles of many sheaths. It differs from the first type of plica only in the absence of a double fold (see Fig. 16). The connective tissue above the sheath is reflected downward over the tendon much

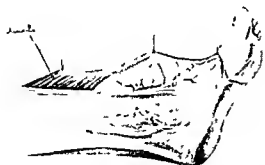


Fig. 19. The blood vessels of the extensor proprius hallucis injected with gelatin cannibar. The sheath has been opened and the tendon lifted out so as to put the mesotenon on the stretch. From the dorsalis pedis artery five branches run through the mesotenon to the hilus of the tendon and form an extensive anastomosis in the epitenon. (The number of branches varies in different individuals, but the principle of the vascular system is constant.)



Fig. 20. Longitudinal microscopical section through the tendon of the extensor proprius hallucis (6 months infant). The vessels were injected previous to fixation with a suspension of Turnbull's blue in glycerin. The drawing shows the vessels in two successive serial sections each 50 microns thick. Note the numerous vessels passing from the mesotenon (*M.T.*) into the tendon. Near the friction surface (*T*) of the tendon, however, no vessels are present.

as the conjunctiva is reflected from the lid to the eye bulb. This type of plica forms the usual distal boundary of the sheath.

These primary anatomical facts and the nomenclature which I have suggested in place

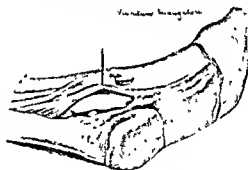


Fig. 21. The vascular system of the flexor digitorum profundus tendon. The vessels injected with gelatin cannibar.

The sheath has been opened and the tendon lifted out so as to demonstrate the vessels running in the epitenon. The epitenon is situated on that surface of the tendon where friction against bone or ligament is least likely, that is, on the convexity of the tendon as it rounds the groove in the tibia astragalus, and calcaneus. The vessels reach the tendon by two main branches: (1) a proximal running either in the lowermost muscular fibers, as in this instance, in the proximal vinculum or in the mesotenon, (2) a distal, running in the distal vinculum triangular or the vascular supply of the tibialis posterior tendon see Fig. 5.

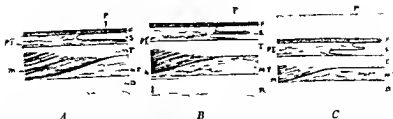


Fig. 22 Three diagrams illustrating what takes place at the upper pole of the sheath of the tibialis anticus tendon during a contraction of the muscle. This invagination mechanism is found only in young muscular individuals. (See Fig. 24 for another type of gliding mechanism.) PT Paratenon, M muscle, P plica, F fascia, S sheath. MT mesotenon, B bone.

of the misleading older terminology can best be summarized by a diagram.

Figure 17 is an ideal longitudinal section through the tendon of the tibialis anticus and the adjacent structures. The *sheath* is interposed between fascia and tendon, where the tendon changes its direction. It does not, as usually maintained, give the tendon an increased range of motion, since the tendon glides as freely above the sheath as within it. Above and below the sheath, between the fascia and the tendon, is interposed the *paratenon*, a loose, vascular, fatty connective tissue rich in elastic fibers. The paratenon is prolonged downward into the sheath as a tongue like fold, the *plica duplicata*, so termed to distinguish it from another type of reflection usually found at the lower pole of the sheath, the *plica simplex*. The *mesotenon*, continuous with the paratenon, connects the tendon with the floor of the sheath and transmits blood-vessels to the tendon. It expands on the surface of the tendon, forming a delicate, almost microscopical layer, the *epitenon*. Paritenon, epitenon, and mesotenon constitute the *esotenon* as opposed to the *endotenon*, the connective tissue strands within the tendon (old terminology *peritenon* and *intimus*). For all the connective tissue structures associated with the tendon the old term *peritenon* may be employed.

2. *The blood vessels of the tendon.* Probably because Koelliker in his classical textbook stated that the tendons contain practically no blood vessels, little attention has been paid to their vascular supply. I know of only two papers dealing with it, those of Wollenberg and of Arai. Wollenberg injected the femoral artery with an emulsion of mercury and turpentine and took roentgenograms of the tendons after these injections. Arai injected with India ink and made microscopical sections. Both papers, though of value, leave many important

points unanswered. To gain a clear conception of the blood supply of tendons, one must combine macroscopical study and microscopical investigations of the tendon. For macroscopical study I injected the femoral artery (after preliminary washing out with saline solution) with a thin gelatin solution colored with cinnabar. This solution penetrated the capillaries and gave excellent pictures of the distribution of the vessels in the mesotenon. For microscopical purposes I found more satisfactory a suspension of Turnbull's blue in glycerine. Tendons thus injected can be fixed in formalin, imbedded in celloidin, cut, and stained in the usual way without affecting the brilliant blue of the dye.

The results of the investigations show that Koelliker's conception of the tendon as practically bloodless is incorrect. Though much less vascular than muscle or the surrounding loose connective tissue, the tendon contains numerous vessels, except near its friction surface. Here practically no blood-vessels are visible. In general the vessels of the tendon are derived from three main sources: (1) from muscular branches, (2) from vessels running in the surrounding connective-tissue paratenon, mesotenon, and the *vincula*, (3) from vessels of the bone and periosteum near the point of insertion of the tendon.

These vessels travel in the hilus of the tendon, in the epitenon, and in the connective-tissue septa between the tendon bundles (the endotenon) and anastomose freely by transverse and oblique branches. Figure 18, a transverse section through the flexor longus hallucis tendon, shows the longitudinal vessels

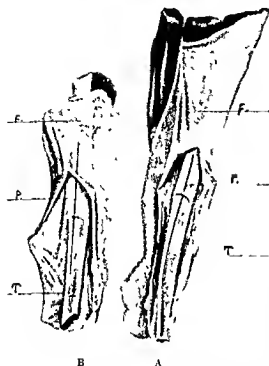


Fig 23 Two drawings of the tendon of the tibialis anterior (A) During the phase of muscular relaxation, (the foot in equinus) (B) During the phase of muscular contraction (the foot in calcaneus) F Fascia, P plica, T tendon free in sheath. In each instance the superficial pocket of the sheath has been opened up to the upper pole, a bristle has been passed into the deep pocket until it encounters the resistance of the reflection of the plica to the tendon (that is the upper pole of the deep pocket, (see Fig 16))

In A the deep pocket is 1.0 cm deep, in B, 2.8 cm. This type of gliding mechanism is found frequently in young individuals and in most adults

cut transversely and some of the transverse and oblique branches cut longitudinally.

The tendons are most vascular near the insertion of the mesotenon, that is, near the hilus. Here the numerous branches of the mesotenon (Fig 19) ramify in the epitendon and send numerous fine twigs into the tendon (Fig 20). Where the mesotenon is absent, the vessels reach the tendon through the vincula and usually give rise to a longitudinal vessel, which runs in the epitendon on the surface of the tendon protected from friction and sends out numerous transverse branches (Fig 21)

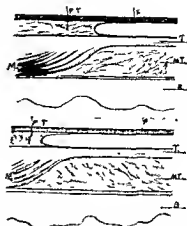


Fig 24 Two diagrams illustrating the gliding mechanism of the plica simplex (tendon of the flexor digitorum profundus), a (above) during the phase of muscular relaxation b (below) during the phase of muscular contraction M Muscle, PT paratenon, F fascia, T tendon, MT mesotenon or vinculum, B bone

The motion of the tendon is allowed by the elasticity of the paratenon and mesotenon, whose fibers are stretched during muscular relaxation, that is, when the antagonistic muscles draw the foot into calcaneus, contracted when the flexor hallucis draws the foot into equinus

An accurate knowledge, not merely of these general principles, but of the vascular system of each individual tendon is of practical value in tendon operations. The tendon of the flexor longus hallucis, for instance, derives its blood supply regularly from a vessel which, reaching the tendon via the proximal vinculum or the lowermost fibers of the muscle, runs downward on its posterior surface (see Fig 21) and anastomoses with a corresponding vessel of the distal vinculum. In transplanting the tendon to replace a paralyzed Achilles tendon, the surgeon can, with a little care, avoid injuring this dorsal vessel and thus insure the viability of the tendon.

3 *The mechanism of the gliding of tendons.* Previous studies of tendons have been concerned almost entirely with their anatomy or their healing process after tenotomy. Despite thousands of tendon operations no one has yet attempted an analysis of certain physiological problems which are of peculiar significance in the technique of tendon operations. I refer particularly to the gliding mechanism of the tendon and to its normal



Fig. 25 Two microscopical longitudinal sections of the lower pole of the tibialis anticus sheath of a dog: a, (at left) during the phase of muscular relaxation (the foot in equinus); b, during the phase of muscular contraction (the foot in calcaneus). b is magnified more highly than a so as to show in detail what occurs when the muscle contracts. We are dealing here with a plica simplex. T Tendon, D distal pocket of the sheath, (in picture at right) distal reflection of the sheath, the plica simplex P plica drawn upward by the tendon S synovial layer of the sheath

tension. The practical importance of these physiological facts is self evident. If the operator wishes to prevent disastrous post-operative adhesions, he must first understand the normal gliding mechanism of the tendon. If he wishes to suture the tendon in such a way as to secure the maximum effect, he must know the laws of tendon tension.

On first thought the gliding of a tendon seems to present no question for investigation. Of course one says, the tendon glides just exactly as two joint surfaces glide over each other, but just as the knowledge of joint motion requires a fine appreciation of many mechanical laws, so too the gliding of the tendon necessitates careful mechanical analysis. The problem is best understood by focusing on a specific example—the tendon of the tibialis anticus, for instance. We have already seen, in considering the anatomy of

tendons, that the tendon sheath is interposed between the fascia and tendon to act as a buffer where the tendon changes its direction. The fascia forms the outer wall of the sheath, and, as the fascia above the malleoli is firmly fixed to fibula and tibia, the complete motion of the tendon, which in an adult ranges between 3 and 4 cm, must occur between the tendon and the wall of the sheath. Between this rigid wall and the bone, the tendon glides much as the piston of an engine glides to and fro within the cylinder. The essential difference, however, between the sheath and the cylinder is that the cylinder is not attached to the piston, whereas the sheath at its upper and lower poles is firmly attached to the tendon. Were cylinder and piston made fast to one another, gliding of the one within the other would be impossible. What, then, allows motion to occur in the case of the tendon? Evidently some mechanical con-



Fig. 26



Fig. 27

Fig. 26 and 27 Two microscopical longitudinal sections through the tendons of the flexor sublimis digitorum (adult). Leitz obj 1 oc 4, tube 130

Fig. 26 Phase of muscular relaxation PT Para tenon P fascia S sheath T tendon, P' plica simplex (stretched)

Fig. 27 Phase of muscular contraction. Point P' represents the same level of the palmar fascia. PT Para tenon P fascia S sheath T tendon P' plica simplex (contracted)

The motion of the tendon (4 cm) has been allowed by the relaxation and contraction of the plica and paratenon

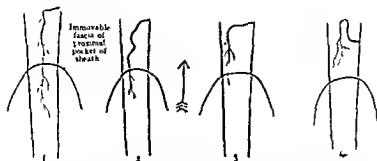


Fig. 28. Four sketches of a blood vessel on the surface of the extensor carpi radialis longus during successive phases of muscular contraction. No. 1 represents the phase of maximal muscular relaxation, No. 4 of maximal contraction. The arrow indicates direction of tendon motion. The fascia of the proximal pocket of the sheath, represented by the bowed line remains almost immovable. The change in the course of the blood vessel indicates the corresponding contraction of the fibers of the paratenon and plica.

trivance must be present by means of which the sheath, though closely united on the one hand to the immovable fascia and on the other to the freely gliding tendon, can, without tearing, accompany every motion of the tendon.

To study this problem three methods were open to me:

1. *Direct observation on the cadaver, controlled by microscopical sections.* The technique was the following. The joints, stiffened by rigor mortis, were mobilized by tenotomy of all the tendons except the one to be studied. Its muscle belly was then freed from its origin and braided for a considerable distance with stout cord, so that by traction on the cord the tendon could be made to move in much the same way as when the normal contraction of the muscle took place. Thus the relations of the tendon, the sheath, the fascia, the plica, the paratenon, and the mesotenon could be studied during all the phases of tendon motion from the extreme contraction of the muscle to its maximal relaxation. The macroscopical observations were in many instances controlled microscopically by sections of the sheath and tendon fixed during a definite phase of muscle contraction.

2. *By animal experimentation.* The amputated leg of a dog was faradized while the muscle cells were still capable of responding

to the electric current, and while thus contracted the limb was plunged into formalin and held there until the muscle cells were fixed in the contracted state. Tendon and muscle were then imbedded in celloidin and microscopical sections prepared. By faradizing antagonistic muscles of the opposite leg, the corresponding tendon could be studied during the phase of muscle relaxation.

3. *Occasionally during operations on human beings,* it was possible to control the results of cadaver observations and animal experiments.

The results of these observations show that each tendon possesses a peculiar gliding mechanism, which varies slightly in each instance but is always dependent upon one basic principle: viz., the peculiar elasticity of the paratenon and the related plica and mesotenon. These facts are best understood by a series of diagrams and pictures.

Figure 22 shows three diagrammatic longitudinal sections through the tendon of the tibialis anticus at its entrance into the sheath. In *A* the muscle is relaxed; the foot is consequently in equinus. In *B* the muscle has partly contracted so that the foot forms an angle of 90° with the leg. In *C* the muscle has reached its maximum contraction. The tendon has moved exactly 2.5 cm during the contraction. To permit this range of motion the plica duplicata has

invaginated itself. The fascial wall of the sheath has remained immobile, the upper end of the sheath, however, though attached to the fascia, has, by virtue of the elasticity of the plica, followed the motion of the tendon.

This invagination does not occur in all individuals. I found it usually in children and in young adults. In older individuals and in those whose muscles were not well developed, little invagination took place. The motion occurs chiefly by a deepening of the pocket between the plica and the tendon (see Fig. 23) or in a contraction of the paratenon with little or no change in the form of the plica.

When a *plica simplex* is present, as in the instance of the tendon of the flexor longus hallucis the gliding mechanism is again dependent upon the elasticity of the paratenon. Reduced to the simplest form, the mechanism is represented by Fig. 24. For the details of the mechanism the animal experimentation was of value. Figure 25 shows the distal end of the tibialis anticus sheath of a dog, in one the muscle is relaxed, in the other the muscle is contracted. (For the technique *vide supra*.) During the contraction of the muscle the tendon has drawn the plica with it inside the sheath and the synovial membrane of the sheath has accommodated itself to its new position by numerous folds.

In Figs. 26 and 27 are seen the tendons of the flexor sublimis digitorum of the third and fourth fingers, one when the finger is extended, the other when it is completely flexed. The elongation of the sheath by the contraction of the paratenon and the folding of the synovialis is clearly evident. Figure 28 gives four sketches of a blood vessel on the surface of the tendon during successive phases of the contractions of the muscle. The change in the course of the blood vessel illustrates the corresponding contraction of the fibers of the paratenon.

Above the sheath the gliding of the tendon beneath the comparatively rigid fascia is allowed by this peculiar elasticity of the paratenon. By incising the fascia and lifting the tendon out of its bed one can realize the degree of this elasticity, for the paratenon

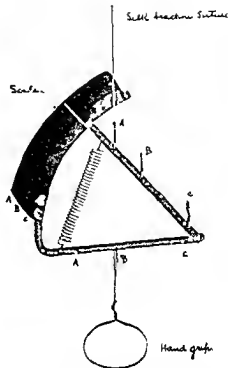


Fig. 29. The spiral spring scale used to determine the tension of the tendon. The three systems A, B, and C permit exact readings from 50 grams to 10 kilos by merely shifting the grip and the silk traction suture. System A gives the finer readings, system C the traction over 1 kilo.

can then be stretched to form a membrane 4 to 6 cm wide.

When describing the mesotenon I called attention to the fact that its width diminishes as the tendon approaches its insertion. The mesotenon of the tibialis anticus or of the extensor proprius hallucis, for instance, is 3 to 5 cm wide at the level of the malleoli, and only 1 or 2 cm wide at the lower pole of the sheath. This anatomical fact illustrates the nicety of the gliding mechanism of the tendon, the width of the mesotenon indicates the degree of motion occurring between the tendon and the bone. Above the malleoli the total motion of the tendon must occur between the tendon and the bone, since the tibia remains fixed during the muscular contraction, whereas below the malleoli the relative motion of tendon against bone diminishes rapidly, since the foot moves

**TABULAR SURVEY OF THE TENDON OF THE TIBIALIS ANTICUS
BASED ON MEASUREMENTS OF 20 ADULTS**

LENGTH OF THE SHEATH		MESOTENDON	RANGE OF TENDON MOTION
	During Phase of Maximal Muscular Relaxation	During Phase of Maximal Muscular Contraction	Present in 100 percent in section into the posterior lateral aspect of the tendon. Maximal width at the level of the malleolus 5.5 to 4.0
Above the intermalleolar line	4.0 to 5.5	5.0 to 7 cm	Adult 55
Below the intermalleolar line	4.5 to 5.0	4.5 to 4.5	Children 15-25 (8 cases)
PLATE			
Proximal = Flexa duplicata			
	During Phase of Maximal Muscular Relaxation	During Phase of Maximal Muscular Contraction	ILLUSTRATION
Length of the superficial pocket	4.5 to 5.5 Average 5.2	6.5 to 8.5 Average 7.0	1 Between the tendons and the internal coniform part the insertion of the tendon. Lessens friction during contraction
Length of the deep pocket	6.5 to 7.5 Average 6.8	8.5 to 10.5 Average 9.5	
Distal = Flexa simplex			
			VASCULAR SYSTEM
			Vessels derived
			1 From genicular branches
			2 From vessels of peroneum and bone at insertion of the tendon
			3 3 to 5 branches of the dorsalis pedis running in the mesotendon
			Form extensive anastomosis in the epitenon in the posterolateral aspect of tendon

with the tendon when the extensor muscles contract

The practical significance of these facts is evident. If the tendons are thus normally equipped with a delicate gliding mechanism, the operator must respect its mechanics. In many instances of tendon transplantations it is possible to retain this gliding apparatus intact, in other instances where the normal mechanism must be interfered with, the operator should try to restore the normal conditions.

4 *The tension of the tendon* The tension of a tendon is of as great practical significance as the mechanism of its motion. By a happy coincidence Dr. Stoffel of Mannheim has been investigating this question of tendon tension and his results, based upon quite a different mode of study, are in full accord with mine. My experiments were performed chiefly on dogs. A few control observations were also made in the course of operations on human beings. The exact question which I wished to determine was: What is the tension of a tendon when the muscle is at rest and the individual under deep narcosis? This is the all-important practical question, for the operator who wishes to perform a tendon plastic physiologically, must suture the transplanted tendon under this tension.

The technique of the experiments was the

following: The tendon, usually the tibialis anticus or the Achilles tendon was laid bare 2 cm. above its point of insertion. The tendon was securely braided by an overlapping stitch in such a way as to allow traction of at least 20 pounds upon the silk suture without tearing it out of the tendon. The tendon was then divided just distal to the silk strands and a delicate spiral scale (Fig. 29) attached to the silk, by means of which the tension of the tendon could be accurately measured. All one had to do was to pull on the handle of the scale until the two divided ends of the tendon were brought into contact. The results of these measurements showed: First that when the origin and the insertion of a muscle and its tendon were approximated, the tendon under the condition of the experiment (deep narcosis) was entirely without tension. The delicate spiral scale showed exactly at zero. Second that when origin and insertion were separated to the physiological limit it required a traction of 300 to 500 grams to unite the tendon ends, in other words the tendon is under tension. In the case of the Achilles tendon two other peculiar facts could be demonstrated. When the dog's knee was flexed and at the same time the foot was brought into a position of equinus, the tendon ends actually overlapped, i.e., the tendon was under negative tension. Conversely, when the knee was extended and

the foot brought into the position of calcaneus, it was absolutely impossible, even with a traction of 30 pounds to bring the tendon stumps together, muscle and tendon evidently were being taxed beyond their normal physiological limit. Ludwig Fick, in his *Anatomie der Gelenke*, has also called attention to this peculiarity of muscles which run over two joints and has labelled such muscles actively or passively insufficient.

Muscle and tendon have a definite length, happily termed by Stoffel their physiological length. This length can vary within the range of the normal motion of the joints bridged by the muscle and tendon. If an abnormal position of the joints is assumed as for instance in the case of the dog, flexion of the knee and extension of the foot, tendon and muscle are unable to accommodate themselves to this unusual demand.

When a muscle is faradized the tension of the tendon varies directly with the strength of the current and the strength of the muscle. In dogs weighing 15 to 20 pounds, the tension of the tendon during contraction of the muscle ranged from 800 to 10,000 grams. Also in those experiments where the muscle was allowed to contract voluntarily as the animal awoke out of the anesthesia similar readings were made.

The practical application of these laws is simple. To restore the normal tension the operator need only approximate origin and insertion of the muscle and tendon in question and suture the tendon to its new position without any tension whatsoever. For instance in transplanting the peroneal tendon for the paralyzed tibialis anticus, the foot should be held in the position of calcaneovarus and the peroneal tendon sutured to its new point of insertion with just sufficient tension to render it taut.

II THE ANATOMY AND PHYSIOLOGY OF THE INDIVIDUAL TENDONS

I have now outlined the general facts of tendon anatomy and physiology. The con-

scientious surgeon, who wishes to perform tendon operations with the maximal benefit to his patients should be acquainted not merely with these general facts but with the exact anatomy of each individual tendon. In these papers it is impossible to condense this mass of details the surgeon is referred to the monograph *Die physiologische Sehnenverpflanzung*¹ by Biesalski and Mayer. I append a tabular survey of the tendon of the tibialis anticus to indicate the nature of the anatomical study of the individual tendons.

SUMMARY

In this, the first of three papers dealing with the physiological method of tendon transplantation, I have outlined the inception of the research and the basic facts of tendon anatomy and physiology. The research is the logical outgrowth of an extensive series of animal experiments conducted during 1912 in the clinic of Professor Lange, Munich, in which the principle of Biesalski's tendon operation—the restoration of the normal relationship between tendon and sheath—was given ample experimental verification. The natural sequence was the perfection of the technique of Biesalski's operation so as to render it physiologically correct in all its various phases.

To do this the hitherto vague or unknown finer anatomy and physiology of tendons had to be investigated by anatomical dissection, controlled by microscopical preparations by animal experiments and by observations at the operating table. Thus equipped with more accurate, though still far from complete knowledge of the physiology of tendons, it has been possible to formulate an operative technique in which these facts are the foundation.

In the second paper I shall describe in detail three typical physiological tendon transplantations, in the third, I shall report the experimental and clinical results of the physiological method.

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FRACTURE OF THE VERTEBRÆ WITHOUT CORD SYMPTOMS

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FRACTURE of the vertebræ without cord symptoms of sufficient severity to attract attention is a condition frequently allowed to go unrecognized, yet it is not uncommon. In the past year four cases of this nature have come under the writer's observation and in all but one the patients were discharged from hospitals with the assurance that they were physically sound. It goes almost without saying that fracture of a vertebral body is fraught with serious possibilities if not properly treated. Even though the immediate results of such an injury are apparently trifling, the broken bone may undergo a process of rarefaction and attrition with the appearance some months later, of cord symptoms, increase of deformity, pain, and weakness. The import-

ance, therefore, of careful examination of all spine injuries is obvious. It is possible that failure to recognize lesions of this type is due to the very prevalent idea that fractures of the vertebræ are always accompanied by evidence of cord pressure. Such is the impression to be gained from most textbooks on the subject which specifically state to quote from one well known author, that in fracture of the spine "paralysis is the most important and constant symptom," while nothing is said of the possibility of fracture without this condition. Thus occurs the belief among those whose practice is not chiefly concerned with bone and joint work that the absence of paralysis in one form or another is a reasonable basis for excluding vertebral fracture. It is true, nevertheless, as Case 2 well illustrates, that there may be fracture of more than one vertebra with displacement of fragments without interference with locomotion or vesical or rectal control. In traumatism of the spine the



Fig. 1. Case 1. Fracture of first lumbar vertebra showing typical posture.



Fig. 2. Case 1. Fracture of first lumbar vertebra with displacement of fragment.



Fig 3 Case 2 Fracture of sixth and seventh dorsal vertebrae with rounded deformity of spine

presence of paralysis is suggestive of fracture yet it is not conclusive inasmuch as cord pressure from hemorrhage may produce a loss of muscular power. Of greater importance in determining the probability of fracture is examination of the spine for a point of localized tenderness. If this is found and is accompanied by deformity such as a sharp knuckle or a rounded curve which is the more frequent abnormality fracture may be assumed. The findings will be confirmed or disproved by radiographs provided they are well taken. For this purpose apparatus of high penetration is often necessary. It is not sufficient to depend upon an X-ray plant which may be efficient for ordinary work especially if the injury involves one of the upper seven dorsal vertebrae. In this situation the scapula are interposed between the plate and the tube and offer sufficient resistance to the X rays to yield indistinct shadows unless the penetration is unusually high. This point is well illustrated in Case 2 in which two sets

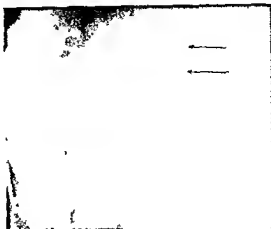


Fig 4 Case 2 Lateral view showing crushing of two vertebrae

of plates taken with an apparatus of ample power for ordinary bone work, failed to reveal the fractures which were afterward clearly demonstrated by a plate taken by the same radiographer, using a machine of higher penetration.

While it may be that many cases of compression fracture of the vertebral bodies eventually recover without special treatment it is unsafe to assume that all will do so. Case 3, for instance, had no cord symptoms until ten months after injury, when weakness of legs developed followed by paraplegia which it may be assumed, was due to absorption of the crushed spongy tissue permitting further collapse of the unsupported spine, with consequent pressure on the cord. Cases 1 and 2 while having no paralysis, complained of their inability to resume hard work because, on lifting heavy weights their backs seemed weak and were somewhat painful. Both recovered by the aid of a properly fitting brace. Where external mechanical support fails after a reasonable period the insertion of a bone graft to include two spines above and two spines below the injury would seem to be indicated, but in none of the cases of this series was such procedure considered necessary.

The type of deformity usually produced by fractures of this nature is a long rounded



Fig. 3 Case 2 Anteroposterior view showing crushing of two vertebrae



Fig. 6 Case 3 Lateral view showing severe crushing of vertebral body and displacement of fragment

curve, differing somewhat in its appearance from the kyphos of Pott's disease which in acute cases partakes of shorter and sharper lines (Figs 1, 4, and 8)

Of subjective symptoms one case complained of occasional dizziness which disappeared entirely when external support was applied, and the others only of pain on bending the spine, and weakness

CASE 1 M J C age 40 Fell a distance of fifteen feet striking his back. Was assisted to his home and remained in bed two weeks. Had no loss of power in legs and no bladder or rectal symptoms. Was then allowed up, apparently well, but in attempting to resume his work as a carpenter, found he was unable to do any lifting. Ten weeks later he was referred to the writer for advice. Up to this time no diagnosis of fracture had been made. There was present in the dorsolumbar region a rounded deformity (Fig. 1) and a point of distinct tenderness over the first lumbar vertebra. Fracture was suspected and a radiograph showed the first lumbar vertebra crushed into a wedge shaped mass (Fig. 2). A Taylor spinal brace was applied, to be worn night and day, four weeks rest enjoined, and the man has since been at work without symptoms.

CASE 2 E W, age 32 Fell from a tall cherry tree. Position on landing not known. Was unconscious when picked up and did not regain consciousness for an hour and a half. Complained of

pain in shoulder and at a point corresponding to the sixth dorsal vertebra. Right clavicle fractured. No paralysis of legs, no interference with bowels or bladder. Was taken to a hospital where he remained in bed eight days, treated for contusion, discharged as recovered. His family at once noticed decided round shoulders (Fig. 3), which he did not have before the accident, and patient complained of pain between the scapulae, with occasional attacks of dizziness. Eight weeks later he appeared at the Hospital for Ruptured and Crippled for advice as to his round shoulders and pain. There was a point of tenderness over the sixth dorsal vertebral spine. Two sets of radiographs failed to reveal any bone lesion but a third, taken by Dr B C Darling with an apparatus of high penetrating power showed fracture of the bodies of the fifth and sixth dorsal vertebrae with displacement of fragments (Figs 4 and 5). A spinal support was applied to be worn day and night. The occasional dizziness disappeared and the man has since had no symptoms.

CASE 3 P O D male, age 35 Fell October 27, 1913, a distance of fifteen feet from a scaffolding and a beam fell across his left shoulder, fracturing the clavicle and dislocating the shoulder. He was in a hospital for several weeks where the clavicle and shoulder were treated, but nothing was done for the spine. He had no paralysis and, when seen at the Hospital for Ruptured and Crippled seven months later, walked well but complained of tiring easily. He said he had never had any trouble with bladder or bowels. He had a rounded deformity in



Fig 7 Case 4. Fracture of tenth dorsal vertebra showing rounded deformity of spine



Fig 8 Case 4. Lateral view of spine showing crushing of tenth dorsal vertebra

the lower dorsal region and a point of tenderness over the tenth dorsal vertebra. A radiograph showed severe crushing of this bone and displacement of the anterior fragment (Fig 6). A spinal brace was applied but the patient would not wear it at night. Two months later his wife reported that he was unable to walk. As he lived at a distance from New York he was advised to seek surgical aid in his own city.

CASE 4. F. W. female, age 16. Fell off the steps leading to her house and was taken to Bellevue Hospital for treatment. She was X-rayed but no

fracture discovered. Discharged after two weeks as recovered. Three weeks later sought advice for deformity of spine. There was a marked rounded kyphos in the mid dorsal region (Fig 7), with a tender point at its apex over the tenth dorsal vertebra. Diagnosis of fracture was made which was confirmed by a radiograph (Fig 8). She said she had never had any paralysis and complained at the time only of a sense of general weakness and of tiring easily. Spinal brace was applied to be worn day and night. All feeling of weakness has disappeared and patient is without symptoms.

RENAL DYSTOPIA

WITH A REPORT OF TWO CASES

BY THOMAS N. HEPBURN, A.M., M.D., I.A.C.S., HARTFORD, CONNECTICUT

IN January, 1913, Dr. S. C. Plummer of Chicago published in *SURGERY, GYNECOLOGY AND OBSTETRICS* an article on "Dystopic Kidney" in which he reviewed the literature to date of the clinical cases reported. This included 67 cases collected by Straeter, to which he added 17 cases, making a total of 84 clinical cases reported. Of these 84 cases, 63 were operated upon, and some renal surgery was done in 48 cases.

In 34 cases, nephrectomy was done: 23 recovered, 7 died, 4, no report of result.

In 3 cases, nephrotomy or pyelotomy was done: 1 recovered, 2 died.

In 3 cases, calculi were removed, recovered.

In 3 cases, the kidney's position was changed by reimplantation: all recovered.

In 3 cases, part of the kidney was excised: 2 died, 1 not reported.

In 1 case, the kidney was fixed to the abdominal wall, result not stated.

In 1 case, nephrectomy was attempted, but the patient died.

A most instructive fact brought out in Plummer's paper was the large proportion of nephrectomies done, 34 of them.

In 14 of these cases, the kidney was either hydronephrotic or pyonephrotic: 13 recovered; 1 died.

In 13 of these cases, the kidney was physiologically normal: 10 recovered; 3 died.

In 3 cases, the only kidney was removed and all died.

In 4 cases, the condition and result are not stated.

From the above statistics, it seems advisable to draw the following conclusions in regard to dystopic kidneys:

1. Do careful diagnostic work before operating so as to assure yourself that there are two kidneys present, and determine the functional capacity of each.

2. Unless the dystopic kidney is functionally impaired by disease, except in pelvic



Fig. 1. X-ray of sigmoid, Case 2, showing large shadow.



Fig. 2. X-ray, Case 2. No connection shown between two shadows.



Fig 3 X ray, Case 2, showing catheters in situ, right catheter against stone shadow

kidneys of women who are likely to become pregnant, nephrectomy should not be done

To the above series of cases, I wish to add two

CASE 1 Mrs A K, age 25, mill worker, German, referred by Dr O C Smith. History was negative except for the present illness which was a complaint of pain in left pelvis for past 5 years. At times had had dysuria of mild degree. The non catheterized urine showed a few pus-cells. The temperature was normal. A vaginal examination showed a mass in left pelvis taken to be a fibroid of the uterus. In order to insert guiding catheters for a contemplated hysterectomy, I cystoscoped her. This revealed

The bladder wall slightly congested

Right ureteral os normal, admitting a No 7 catheter easily 25 cm, and clear urine flowed rapidly. A specimen of this urine was reported normal by the laboratory. Left ureteral os appeared normal but would admit a catheter only 4 cm. Six gm of phenol-sulphonaphthalein was injected intravenously. It was excreted by the right kidney in 4 minutes and in 30 minutes, 35 per cent. None found from the left catheter or in the bladder.

A diagnosis was made of left ureteral obstruction (probably due to pressure of a pelvic tumor) and degeneration of left kidney with functional compensation of right kidney. Exploration of the pelvis was advised.

Operation, January 27 1914, by Drs O C Smith and Hepburn. Through a median suprapubic incision, the uterus was found normal. In the left pelvis

was a cystic mass, very adherent to the surrounding structures. As we peeled it out, it appeared to be either in or under the broad ligament. When removed, it proved to be full of turbid fluid, and it was turned over to Dr Henry C Russ for pathological examination. Appreciating now for the first time that it might be a dystopic kidney, the left kidney was searched for but not found. The wound was closed and the patient made a complete recovery. Dr Russ reported on the specimen as follows:

Cystic mass removed from the region of the left broad ligament. The external surface is smooth except for fibrous adhesions, and is of a purplish, somewhat mottled, appearance. The mass is nearly spherical, and about 10 cm in diameter. The wall is thin and membranous except near the site of attachment, where there is a small amount of firm, nodular, gray tissue. In this tissue is part of a tube, ending blindly in the cyst wall, and cut across distally. It is about 3 mm in diameter and lined by mucous membrane. The internal surface of the cyst shows numerous trabeculations. The lining is shiny.

The cyst content is yellow in color and clear, and has a slightly urinous odor. It is alkaline to litmus and does not respond to tests for urea. It contains a very large amount of albumin and microscopically there are a few flattened epithelial cells and blood-corpuscles.

Histologic examination. Sections show fibrous tissue infiltrated with lymphocytes and polymorphonuclear leucocytes. Distinct kidney parenchyma does not appear though in many places are fairly definite, isolated tubules and in others are found sclerotic tufts containing capillaries and surrounded by an endothelial capsule, very much like degenerated glomeruli.

The inflammatory process is distinctly granulomatous in type, frequent nodules being found whose centers are fibrous while concentrically around are epithelioid cells and numerous lymphocytes and polymorphonuclear leucocytes. In some of these nodules, structures very similar to giant cells, are found.

Diagnosis. Chronic nephritis with marked hydropnephrosis—biliary tubercles.

CASE 2 On November 18, 1914 Mr E C B of Meriden, Connecticut, was referred by Dr O C Smith for diagnosis. He was 53 years old, married, a collector. An American. Complaint. Indefinite pain in left lower abdomen, suspected to be some trouble with sigmoid. His family history is unimportant. His past history is negative except that he has had this pain to some degree for over 30 years and that he thinks he passed two stones from his left kidney 8 years ago. General examination shows a rugged, healthy looking man, with nothing pathological to be seen or felt locally.

An X ray of the sigmoid was taken and a large shadow was revealed, as shown in picture (Fig 1). Some thought this to be in the bladder but a cystoscopy showed the bladder clear. To exclude the

possibility of its being a large calculus in a bladder diverticulum, the opening of which was so small I had overlooked it. I filled the bladder with 40 per cent argyrol and X-rayed again. The picture (Fig. 2) showed no connection between the two shadows and I was able to rule out diverticulum. I then became suspicious of a dystopic kidney and sent him into the Hartford Hospital so that I could give him a complete renal examination. Cystoscopy, double ureteral catheterization, quantitative differential renal function, and X-ray with catheters *in situ*. The bladder was normal. The right ureteral os was normal. It admitted a No. 7 catheter 14 cm., and clear urine flowed well. A sterile specimen sent to the laboratory is reported to contain leucocytes and red blood cells, but there is no growth on culture media.

The left ureteral os was normal. It admitted a No. 7 catheter 25 cm. and clear urine flowed well. A sterile specimen sent to the laboratory is reported normal.

Six milligrams of phenolsulphonephthalein was injected into the arm vein.

The left kidney excreted it in 4 minutes and in 30 minutes, 30 per cent. The right kidney excreted it in 5 minutes and in 30 minutes, 39 per cent.

The patient was then X-rayed with the catheters *in situ* and the right catheter was found to be against the stone shadow (see Fig. 3).

A definite diagnosis was then made of a calculus in a right dystopic kidney of normal function, a normal left kidney being present.

Operation, December 8, 1914. Drs. O. C. Smith, Bell, Hephurn, and E. O. Smith of Meriden. A midline suprapubic incision was made. The peritoneum was peeled off from bladder. The stone was at once felt in the pelvis of a normal-sized kidney, the cortex of which lay against the right horn of the small skeletal pelvis and two-thirds below it. While freeing the stone, which was 5 cm. in diameter, and therefore required a large opening in the renal pelvis, a renal vein, apparently coming off the right common iliac, was ruptured and this hemorrhage required packing, so that no further investigation of the blood supply for scientific purposes seemed justified. Because of the normal function of the kidney, nephrectomy did not seem advisable. A cigarette drain was put down to the renal pelvis and the bleeding vein area was packed with gauze, which entirely controlled the hemorrhage. The patient made a most satisfactory recovery with cessation of all painful symptoms.

ENORMOUS ABDOMINAL CYST, PROBABLY DUE TO A RETAINED TESTIS

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Surgeon to the Swedish and Lutheran Hospitals

AND

LOGAN CLENDING, M.D., KANSAS CITY, MISSOURI

IN one of the most delightful papers he has written since his residence in England Sir William Osler¹ calls attention to the diagnosis of abdominal tumors in the male and states that no such diagnosis is complete unless an examination of the testis has been made. It might be added that the most important thing to find about the testes in such cases is that one or the other is not there.

Osler's three cases were of sarcoma due to a retained abdominal testis.

Bulkley² reports two cases of a similar nature and abstracts the histories of 57 other cases from the literature. He makes a very interesting and complete review of the litera-



Fig. 1. View of patient showing location of the tumor.

¹ *Lancet* Lond. 1905, 1, 1200.
² *Prog. Gynec. & Obst.* Nov. No. 6.

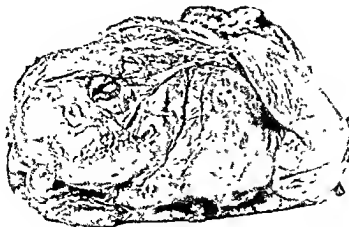


Fig. 2 The tumor removed at autopsy, kidney at left spleen at right

ture on the general subject of malignant disease of the testicle retained in the abdominal cavity, so that we do not intend to go into this matter here.

No mention is made in either Bulkley's or Osler's articles of a case similar to the one which we desire to report here, in no case was so large a tumor discovered, in none a cystic tumor at all approaching this one in size.

CASE 1 This tumor had been noticed by the patient a man of 63, for 15 years. It had grown very rapidly, however, for the last three years before it was operated on October 14, 1913. The patient's family history was negative. His personal history was of little moment save for the fact that he had never had but one testis in his scrotum there being no trace of a testis in either inguinal canal. The tumor caused him great distress and dyspnea but no acute pain. He thought that it had sometimes receded in size and then slowly come up again.

He was an emaciated man with an enormous abdomen. His arteries were sclerotic.

The tumor extended from the lower edge of the left costal arch nearly to the crest of the pubes filling the entire side of the abdomen and extending nearly a hand's breadth to the right of the umbilicus. It fluctuated. It was not movable. There was no tympany over it. (It may be remarked here that the transverse colon was found at autopsy, lying squarely across the tumor showing the lack of value of this old clinical sign in large tumors.)

The hemoglobin was 84 per cent. reds 4,500,000, whites 6,000.

Laparotomy was done October 14, 1913 the in-

cision being made at the left border of the left rectus. An enormous cystic tumor covered with a network of large veins was exposed. The splenic flexure of the transverse colon was over it and attached to it. A trocar removed two gallons (by measurement) of brownish opaque fluid the color and consistency of coffee after cream has been added to it. There were many globules of fat floating in it. After it was removed, the opening was widened and masses of cheesy material evacuated (perhaps cholesterolin, perhaps organized fibrin). Any attempt to remove it would have been impossible. The walls of the cyst were sutured to the abdominal parietes.

The patient died in shock six hours after operation.

A partial autopsy was permitted and the findings, condensed and abridged, were:

In endeavoring to remove the cyst it was found to have dense attachments to the left dome of the diaphragm to the side of the parietal wall, to the spleen, to the left kidney, to the vertebra and to the splenic flexure. The left kidney was spread out over it at one point and had two small cysts in the parenchyma. The ureter was densely imbedded in the wall of the cyst.

The tail of the pancreas was discreet and not involved in the tumor. The spleen was attached to it forming the wall of the cyst at one point.

There was only one testis in the scrotum. No other testis was found in the inguinal canal or in the abdomen on either side after careful search.

The tumor after its removal was stuffed with cotton to take the place of the fluid removed from it and measured twenty two inches long, eighteen inches wide and thirteen inches high.

Sections taken from it at many places failed to reveal any testicular tissue or any evidences of malignant cells. They merely showed the fibrous connective tissue of the wall of the cyst.

CARBOHYDRATE TOLERANCE IN HYPERTHYROIDISM¹

By J CHRISTOPHER O'DAY, M D, PORTLAND OREGON

ON June 16, 1913, a patient came to me for examination and relief. His history follows:

Charles K., age 29, unmarried, carpenter; family history negative. Up to one year before consultation he had always been well. The first symptom he noticed was the appearance of a goiter, and upon consulting a physician he was advised to paint his throat with iodine. As the goiter continued to enlarge, he consulted a second medical man who placed him on the internal use of thyroid extract.

"In a short time," he said, "I was nervous and shaky and went to doctor number three." From his description, it would seem that he was this time treated by the high frequency current, which cured his nervousness but did not reduce the size of the goiter.

In the early part of May, 1913, five or six weeks before his coming to me, he suffered a severe dermatitis of the free neck, arms, hands, and the greater portion of the body from rhus toxicodendron. The effect of the "poison oak" endured about two weeks, and when it was well subsided he began to feel very nervous and to lose in weight. In short, he enumerated the classical symptoms of two diseases, namely, diabetes mellitus and exophthalmic goiter. That the two diseases were in any way dependent upon each other, did not occur to me at the time. I merely regarded their presence as a coincidence.

At about this time, Franklin C. McLean was working out the clinical significance of the sugar content of the blood in diabetes,² and the patient was requested to present himself at the McLean clinic to the end that he receive detailed attention.

A total restriction of the carbohydrates was unavailing in securing sugar-free urine, and while the percentage was markedly reduced the sugar content of the blood remained unchanged. Later he developed a cough and examination of the sputum made in the McLean laboratory revealed the bacilli of tuberculosis. December 19, 1913, the patient lapsed into coma and died.

My reason for referring to this case now is twofold: (1) At the time I did not know that hyperthyroidism was an etiological factor in diabetes. (2) The citation of the case may serve as a control while considering the following two similar cases.

On August 22, 1914, Carl C.,³ age 24, came to us, presenting the same syndrome as in the above

case. It being my opinion that he, too, would die within a few months, I so informed his parents. They had already received this opinion and were not surprised.

Having acquired some experience in the treatment of toxic goiter with the boiling water injection method of Porter, I applied it in this goiter jointly with the usual dietary treatment common to diabetes. He was admitted to the Good Samaritan Hospital the same day. Table I will show the rapid regaining of his carbohydrate tolerance, due we believe, to the "coking" of his thyroid gland.

TABLE I

Date	Specific Gravity	Sugar	Injections of boiling water in minutes	Diet
Aug. 23	1.036	Yes	60	No carbohydrates
Aug. 24	1.036	Yes	30	No carbohydrates
Aug. 25	1.024	Yes	60	No carbohydrates
Aug. 26	1.030	Yes	60	No carbohydrates
Aug. 27	1.020	No	60	One slice white bread
Aug. 28	1.022	No	60	One slice white bread
Aug. 29	1.010	No	30	One slice white bread
Aug. 30	1.018	No	30	One slice white bread
Aug. 31	1.016	No	60	One slice white bread with each meal

At the beginning of the boiling water destruction of his thyroid, the pulse ranged between 120 and 130 per minute. By the end of the month it was between 90 and 100. During the week following as no change had taken place in his condition, we felt safe in attempting extirpation of the gland, and under the pretense of making the last, but largest injection of the boiling water, he was induced to take an anæsthetic, after which the operation was performed after the coffer damming method of O'Day.

His recovery was surprisingly rapid, and within a comparatively short time his ingestion was totally unrestricted. Sugar was finally added in way of candies as a test, but his tolerance remained normal, determined by repeated examinations of the urine.

The very next month, October, 1914, my attention was called to an article in *The Monthly Cyclopædia and Medical Bulletin*, by Paul Sainton, M.D., and Paul Gastaud, M.D., of Paris, France. I will here acknowledge my indebtedness to these two gentlemen for the knowledge I gained from their splendid article, "Exophthalmic Goiter and Diabetes." They reported having met with three instances of diabetes among ninety cases of

¹ J. Am. M. Ass. 120, 917² For detailed report of this case see N. Y. M. J., April 5, 1915³ Read before the Oregon State Medical Society, September 10, 1915

exophthalmic goiter, and after an extensive search of the literature found a total of sixty presenting this combination of conditions. Their findings show the frequency of diabetes in exophthalmic goiter as three in one hundred cases.

"Clinically," they go on to say, "diabetes occurring in the course of Graves' disease is manifest in two ways. (1) as a temporary or slight glycosuria with the usual symptoms of diabetes only present in a trifling degree, (2) as a well established condition, with all the characteristic symptoms present, the latter frequently even dominating the clinical picture as a whole, mentioning a case reported by F. Muller, where the patient died in coma."

After summarizing the facts collected, reaching the conclusion that hyperthyroidism participates in the production of diabetes, they then admit that other factors should be considered, for they say "Other glandular theories may, however, be put forth and these must be passed in review. Among them is the adrenal theory. Cases in point are uncommon, and the authors know of but one instance in which a patient afflicted with both exophthalmic goiter and Addison's disease showed temporary glycosuria (personal case). Discussion of the possibility of participation of the adrenals in such a glycosuria is rendered necessary by the fact that the Vienna school (Eppinger, Falta, and Rudinger, Eppinger and Hess, Krauss and Friedenthal, Asher) maintains the thyreo-adrenal origin of exophthalmic goiter. This theory is based on the relations supposed to exist between the thyroid, pancreas, and chromaffin system. In hyperthyroidism there would occur inhibition of the pancreas and stimulation of the adrenal function. The theory offers a plausible explanation of the clinical association in question, it being merely necessary to conceive that by reason of the pancreatic and thyreo-adrenal antagonism, the disturbance of pancreatic function might extend to complete suppression of glycogenesis.

"This theory is widely discussed. It has not been proved, indeed, that an increase of adrenal secretion takes place in Basedow's disease, epinephrin is not constantly present in such cases, finally, the association of hyper-

thyroidism with Addison's disease is hardly in favor of this conception. Basedow cases, moreover, do not show any constant change in the blood-pressure. True, Asher has noticed that in certain subjects with thyrotoxicosis the injection of $\frac{1}{4}$ to $\frac{1}{2}$ mg of epinephrin leads to glycosuria. Further investigation is required, however, to confirm the validity of this test. Thus, on the whole, it is difficult to establish the responsibility of the adrenals in the production of diabetes among Basedow cases.

"Such is not the case, however, when one looks up a possible rôle of the pituitary in this direction. The reported cases of coincident exophthalmic goiter, acromegaly, and diabetes afford firm support for this theory. Even clinically, there is a marked resemblance between the severe Basedowian diabetes cases and cases of pituitary diabetes. Pituitary diabetes may show itself in the absence of acromegaly. All authors are agreed that it is due to hyperthyroidism. Claude and Baudouin, in a series of researches, found that in a certain proportion of subjects — arthritic and obese cases — after meal time alone, glycosuria appeared after the injection of pituitary extract. Comparison of these cases with those of glycosuria following thyroid treatment in obesity is of interest in this connection. Clinically and experimentally, there is thus a considerable analogy between Basedowian diabetes and glycosuria, on the one hand, and pituitary diabetes and glycosuria, on the other.

"From the above it seems just to assume that in diabetes coupled with exophthalmic goiter two internally secreting glands may be tentatively held responsible, viz, the thyroid and the pituitary. Can one conceive that these two influences are simultaneously operative in the production of Basedowian diabetes? Such a combination seems not unlikely, in view of the close functional synergism existing between the two organs named. As for the more precise mechanism of the glycolytic process taking place, the question arises whether the hypophysis and thyroid cause, through insufficiency in their functions, some disturbance in virtue of which the sugar is no longer retained in the liver. If they act

TABLE II

Date	Urine		Boiling water injections in minutes	Pulse	Diet
	Specific Gravity	Sugar			
December 5	1.036	Yes	30	150	One slice bread, 1 d
December 6	1.036	Yes	30	160	Same
December 7	1.038	Yes	60	160	Same
December 8	1.034	Yes	60	154	Same
December 9	1.032	Yes	60	150	Same
December 10	1.038	Yes	30	138	Same
December 11	1.018	Yes	60	130	Same
December 12	1.024	Yes	30	130	Same
December 16	1.022	Yes	60	120	Same
December 18	1.020	No		112	Same
December 20	1.020	No	30	108	Two slices bread, 1 d
December 23	1.031	Yes	30	104	Same
December 24	1.036	Yes		103	Same
December 25	1.030	Yes	60	104	Same
December 30	1.034	Yes	60	100	Same
January 1	1.026	Trace		100	Same

through the pancreas, is this action exerted through the intermediation of the sympathetic system or through a hormone? These are further problems in general pathologic physiology which the association of diabetes with exophthalmic goiter brings up for future solution."

At a time too soon for this newly acquired knowledge to have taken form in my mind, the second patient with the same combination consulted us.

Mrs. G., age 40, mother of five children, family history negative, and aside from the menses not appearing till her eighteenth year, the personal history, too, was negative.

In August of 1911, she became ill and on consulting a physician was told she had diabetes. This diagnosis was repeatedly confirmed by medical men to whom she subsequently appealed for relief.

The months which followed, she experienced the pronounced symptoms of the disease, even to a severe pruritus vulvæ. A year passed and the thyroid was seen to be enlarged, and within the few months which followed, appeared the exophthalmus together with the other unmistakable signs of hyperthyroidism. When first seen by us, November 13, 1914, she was a complete wreck, anæmic, hæmaglobin 40 per cent, skin bore a dirty waxy hue, a tinge not unlike that associated with pernicious anemia. By restricting the carbohydrates in total we hoped to free the urine from sugar, and then to gradually reestablish them within control of her tolerance. Up to December 2, little gain had been made, and the same night she developed an acidosis which for a time threatened a

fatal coma. Whiskey, sugar, with enormous doses of bicarbonate of soda (two heaping teaspoons) in a glass of water every half hour for four hours, prevented, we believe, the fatal issue. By December 4, she was entirely over the attack, and the next day, December 5, the injections of boiling water were resumed. Table II was compiled from her daily evening condition.

The neck having become inflamed and tender, we were forced to discontinue the boiling water. However, a fair carbohydrate tolerance was established, with a proportionate decrease in her hyperthyroid symptoms. A gradually improving condition was noted up to January 20, when again the injections of boiling water were resumed. Dr. Laurence Selling who had charge of the laboratory work, reported the disappearance of the sugar content of the blood, and argued the same would follow with the urine when further destruction of her thyroid was accomplished. The days given below are from his table, and represent the last sugar detected in the urine prior to the thyroidectomy performed after a week of sugar-free urine.

TABLE III

Date	Sugar per cent	In Grams
January 22	0.8	1.6
January 24	1	22.5
January 28	1	18
January 29	0.6	13
January 30	0.3	7

February 6, two thirds thyroidectomy.

February 7, acetone, diacetic acid and sugar were present.

Within the hour following the extirpation, a severe post operative hyperthyroidism developed, failure in our coffer damming we believe to have been the cause. The pulse rose to 160, and then for a time the action of the heart seemed but a mere thrill. At the end of the first twelve hours the symptoms of thyroid toxæmia began to subside, but at the end of the twenty-four hours acidosis developed and increased in severity till coma threatened. This was combatted as in the foregoing attack with the addition of the "sugar drip" as modified by Rockey. By the end of the first forty hours the patient was out of danger. The table of Selling shows that by February 8, diacetic acid and acetone were absent, but early in the day the specimen showed levorotation, while later in the day dextrorotation in a slight degree. Acetone odor from the breath was noticed at the same time. The levorotation was 0.2 per cent and the same specimen showed by fermentation test 2 per cent sugar.

February 12, sugar was again detected in the urine—1.3 per cent 13 grams.

February 13, sugar was again found in the urine—1.1 per cent 20 grams.

Within two weeks the goiter symptoms had vanished, her pulse having fallen into the 80's, and

with this came the return of what may practically be regarded normal carbohydrate tolerance

Since the foregoing experience we have made an extensive review of all known conditions in the production of glycosuria, and from it, we feel that the glycosuria of hyperthyroidism is exclusive in producing the classical signs of diabetes mellitus

The glycosuria occasionally associated with acromegaly and gigantism Cushing ascribes to hyperpituitarism, and von Noorden differentiates this from true diabetes by attention to the marked variation of the former. Later, it was observed by Cushing that persons acquiring adiposity while suffering from unmistakable hypophyseal deficiency associated with destructive pathologic process, similarly showed a high, often an extraordinary tolerance for sugars, and this seems to tally with all that has been observed with similar lesions of the thyroid

Glycosuria has not been observed associated with lesions of the adrenals in a way to warrant a belief in there being a relation to this particular gland

Opie¹ makes the statement that diabetes

¹ Opie *Diseases of the Pancreas* second edition p. 360

occurring in association with such conditions as arterial sclerosis, cirrhosis of the liver, exophthalmic goiter and acromegaly, is secondary to a lesion of the pancreas accompanying these diseases. Whether this statement is based on theory or actual findings he does not say. Our results with the two cases herein reported would hardly favor this view

If my enthusiasm may be pardoned, it is my earnest belief that the time is not far distant when many of the cases of diabetes will be passed from the internist to the surgeon for treatment, if not for actual cure. This I base on the fact that diabetes is as yet but poorly understood, and that coming research will reveal it to be the result of a hypersecretion of one or more of those ductless glands which, when so perverted, lowers the carbohydrate tolerance of the chemistry of the body

And further, do I see the boiling water method of Porter successfully applied to hyperpituitarism and the destruction of the Gasserian ganglion in tic douloureux with results equally as effective as it has given in exophthalmic goiter

MULTIPLE BENIGN AND MALIGNANT ADENOMA LIMITED TO THE SIGMOID FLEXURE OF THE COLON¹

By HORACE W. SOPER, M.D., St. Louis, Missouri

THE literature of this subject is not extensive. Albu (1), Strauss (2), and Schreiber (3) each report 2 cases of benign multiple adenoma removed by means of the sigmoidoscope. Albu reports 2 cases of malignant degeneration of benign polypi in the sigmoid. One patient declined operation and returned 4 years later with a large cancer of the sigmoid. In the second case resection was done, with recovery.

In 1913, I (4) reported 7 cases of benign multiple adenoma of the sigmoid, removed by means of the snare and cautery. One case presented 6 polypi, the largest one had un-

dergone malignant degeneration, and presented a roughened, cauliflower-like extremity.

Since that report, I have seen 10 cases of single adenoma of the sigmoid and 8 cases of multiple adenoma, all of which were removed by the snare and cautery. In 3 of the cases malignant degeneration of the extremity of a polyp had occurred. The reports of the cases of malignant degeneration follow.

CASE A. Male, age 42, February, 1911. Had observed blood in the stool in small amounts for the past 2 years. No pain, no tenesmus. Three pedunculated growths, one in the ampulla recti, two in the beginning of the sigmoid, of hazel nut size,

¹Read at the meeting of the American Gastro-Enterological Association, Baltimore May 10, 1913.

were removed by the snare and cautery. One showed a roughened extremity, which proved to be malignant adenoma. The patient has been kept under observation since, and no recurrence of the growths has appeared.

Pathologists' reports by Dr R. Buhman, Dr D. L. Harris, and Dr C. Klenk: malignant adenoma.

Abstract of report by Dr D. L. Harris.

"In this case, it is not the gland as a whole which is involved, but rather individual epithelial cells seem to have acquired the property of independent reproduction. The result is that the glandular appearance is soon lost and the individual cells grow at random, columnar cells become cuboidal and round, and have extremely irregular nuclei.

"Sections from this tumor show enormous variations in the height and arrangement of the epithelial cells in a single field. In a single gland tubule one side will be made up of unusually tall, narrow, thread like cells, while on the opposite side the cells will be flat, round, and massed in columns. In many places individual cells grow freely into the surrounding connective tissue. This is a malignant adenoma of the intestine."

CASE B. Male, age 41, February, 1912. Diagnosis made by sigmoidoscopy in a case of spastic constipation. No other symptoms. Two polyps were located at the entrance into the sigmoid, one pea-size, the second one hazel nut size. Both removed by snare and cautery. The larger one showed malignant degeneration (Dr R. Buhman).

CASE C. Female, age 39, July, 1913. She had observed a little blood in the faeces for the past 3 years. Upon sigmoidoscopic examination two polypoid growths were seen 8 inches from the anal margin. The pedicles were long and the two growths came together, so that the wall of the bowel appeared to be involved. A small piece was secured for microscopic examination, and was reported as malignant adenoma (Dr C. Klenk).

Bowel resected, July 21, 1913, by Dr H. G. Mudd. Excision and end to end anastomosis. The patient made a rapid recovery.

Subsequent frequent sigmoidoscopic examinations showed good union. No scar-tissue visible, and no contraction of the bowel.

Three pathologists examined the specimen with

the following diagnoses: adenoma, Dr D. L. Harris, malignant adenoma, Dr C. Klenk, malignant adenoma, Dr R. Buhman.

Without entering into the pathological problems involved, it is obvious that the adenomatous polyp exhibits a decided inclination to develop malignancy. Hauser (5), Albu (1), Schreiber (3), Strauss (2), Doering (6), and others emphasize this tendency. Von Wechsleman (7) states that every malignant adenoma develops from a benign adenoma.

These growths are readily removed by means of the snare and cautery through the sigmoidoscopic tube. Even when malignancy develops in a pedunculated polyp, it is possible to destroy the growth completely without resorting to resection of the bowel.

The adenocarcinoma of the sigmoid grows slowly, and metastasis is late, yet the cases are rarely diagnosed until obstruction is almost complete or the surrounding tissue is so involved that attempts at radical operation are futile.

Finally in the modern campaign against cancer, this field, now so accessible, appears to be neglected. Surely no other region of the body offers better opportunities for early diagnosis, prophylaxis, and treatment.

REFERENCES

1. ALBU, Berl. klin. Wchnschr., 1912, No. 39, 1847.
2. STRAUSS, H. Procto-sigmoidoscopy. Leipzig, 1910, p. 65.
3. SCHREIBER, JULIUS. Die Rektosigmoidoskopie. Berlin, 1911, p. 90.
4. SOPER, H. W. J. Mo. St. M. Ass. 1913 Oct., 130.
5. HAUSER. Deutsche Arch. f. klin. Chir., 1890, 21: 857.
6. DOERING, HANS. Arch. f. klin. Chir., lxxviii, p. 104.
7. WECHSELMAN, LEONARD. Beitr. z. klin. Chir., lxx, p. 855.

THE CORRECTION OF NASAL DEFORMITIES BY MECHANICAL REPLACEMENT AND BY THE TRANSPLANTATION OF BONE¹

By WILLIAM WESLEY CARTER, A.M., M.D., F.A.C.S., NEW YORK

FROM the point of view which I have maintained in my work on deformities of the nose, the framework is the basic, essential structure with which we have to deal. This framework, which constitutes the nasal arch, may be considered an arc built up of an indefinite number of segments assembled on a curved line in such a way as to retain their position when the structure is supported extraneously only at its two extremities. Broadly speaking the displacement of one or more of these segments produces a deformity amenable to the bridge splint operation, while the absence of one or more of these segments would suggest the transplantation of bone to replace it. Upon these principles rests the foundation for my methods of treating the class of nasal deformities toward which my efforts have been especially directed.

The septum strengthens the nasal arch, but it does not support it, for it may be entirely removed without endangering this structure provided that its upper edge, which acts as the keystone of the arch, is left undisturbed. Several cases of depressed deformity of the nose have come under my observation which resulted from the submucous operation, the keystone of the arch having been destroyed either at the time of the operation or by a subsequent infection.

The proper use of a mechanical contrivance for the correction of a nasal deformity necessitates that we have already fixed in our mind not only the results which we wish to accomplish but what is of far greater importance we must understand the mechanics of the apparatus employed. The lines of force exerted by a mechanical appliance are definite and invariable, and when it is applied the results obtained are fixed with mathematical precision.

The action of the bridge splint is intended to duplicate the forces employed by Nature

in the development of the flattened nose of the infant into the more prominent organ of the adult. When it is applied in the case of a depressed deformity it corrects this by reversing the direction of the force that produced it. The use of this instrument presupposes that there remains in the nose a sufficient amount of bony and cartilaginous framework to sustain it in its proper position after the removal of the artificial support.

The bridge splint, with which many of you are already familiar, consists of two fenestrated, curved steel wings hinged together in the middle. The edges of these wings are padded with rubber and the distance to which they can be separated is regulated by a thumb-screw. To be used in connection with this bridge are two intranasal splints which are molded out of sheet gutta-percha at the time of the operation and made to conform to the roof of the patient's nose. These are attached to silk sutures which are threaded into large curved needles.

Thorough mobilization of the framework in old cases is essential and is accomplished by means of a specially devised chisel-forceps, a chisel for intranasal use, and the Adams forceps.

The chisel forceps has a flat blade which is padded with rubber to protect the skin and when used rests on the outside of the nose. On the end of the other blade, and at right angles to it, is a narrow chisel. This blade is passed into the nose and is used to cut through the nasal bones near their attachment to the frontal. The depth to which the chisel can cut is regulated by a set-screw on the handle of the instrument.

The intranasal chisel is used for separating the nasal bones from the nasal processes of the superior maxilla, or for splitting off a portion of the latter for use in building up the nasal arch. This instrument consists of a narrow chisel protected on either side by a

¹ Presented as a Candidate's Thesis to the American Laryngological, Rhinological and Otolological Society.

blunt guide. The shaft is slender and near the handle is a cross-bar to facilitate the turning of the instrument in splitting off the piece of bone.

The Adams forceps is used for general mobilization of the tissues.

In describing the use of the bridge splint, we will assume that we have a broad, irregularly flattened nose due to traumatism. The interior of such a nose is always badly deformed, the septum is crushed, and one or both nasal cavities is obstructed. We will find that the nasal bones have been broken or disarticulated from their attachments to the frontal bone and that they override the nasal processes of the superior maxilla, which may also be broken. The cartilaginous dorsum has become detached from the ends of the nasal bones and at this point there is a steplike depression. The intranasal condition is frequently the predominant cause of the patient's discomfort, and the fact that this too may be relieved by the bridge splint is one of the strongest points in favor of its use. If, however, we have a massive, irregular septum it is better to do a submucous operation before putting on the bridge splint. If the patient is under fourteen years of age, Gleason's operation is recommended instead of the submucous.

In such a case as I have described we must first completely mobilize the entire framework of the nose by means of the instruments I have mentioned. The bridge splint is then applied in the following manner. The sutures to which the intranasal splints are attached are passed from within the nose through the cartilaginous dorsum just below the ends of the nasal bones. By means of these sutures the splints are pulled up against the roof of the nose. The lower ends of the splints should lie just within the vestibules and the upper ends partially beneath the nasal bones. The bridge, the wings of which have been well padded with gauze is then placed over the nose. The sutures attached to the intranasal splints are passed through corresponding fenestræ in the bridge and the dorsum of the nose lifted to the desired height, they are then tied together over the hinge of the bridge.

The bony side-walls are then moved nearer together by means of the adjustment screw, this narrows the base of the nasal arch.

It will be seen that the opposing forces applied by means of this instrument tend to construct a normal nose. It will also be observed that these forces equalize each other, and therefore the instrument is self-retaining; in fact, it cannot be easily displaced. It should remain on about two weeks, but the bridge should be loosened up each day and the spot on either side of the nose where the wings rest should be bathed with alcohol in order to guard against necrosis of the skin.

In bridge splint cases bony union occurs in three weeks, and the gaps between the bones are usually filled in six weeks.

If the septum is too short, which is frequently the case, it can be readily understood that it will hold the dorsum of the nose down when the attempt is made to raise it. In such cases the septum may be lengthened in two ways: First, by making a diagonal incision through the septum from the floor of one nostril upward to the roof of the other. Then when the bridge of the nose is raised the two segments slide partially by each other and the septum is lengthened without leaving a perforation.

By the second method the septum is built up in the following manner. By means of a sharp, two-edged knife a flap including a portion of the lateral cartilage is cut from the sides and roof of each nasal cavity, and the incisions are joined from side to side, under the dorsum of the nose. The flaps being attached by their pedicles to the septum, are lifted up and fall together when the intranasal splints are supplied. We thus add materially to the height of the septum, which then supports the bridge in its elevated position. This method is particularly useful where there is a steplike depression at the ends of the nasal bones.

I have on several occasions used this method for correcting slight depressions of the cartilaginous dorsum without applying the bridge splint. When this is done the flaps are held in their proper position by means of crossed mattress sutures which pass through the dorsum of the nose.

My experience with the bridge splint during the past seven years has been most satisfactory. I regard it as the ideal method for treating both recent and old traumatic cases, lateral deformities, etc. In fact, its use is indicated in all of those cases where there is displacement (not destruction) of some of the primary segments of the nasal arch.

Some of my oldest cases have been under constant observation, and I can assure you that the good results obtained by this operation have been maintained, and in the case of children their noses have attained to the symmetrical proportions of normal adult organs. I would particularly recommend the use of this instrument in fresh fractures where there has been considerable crushing of the bony parts. In these cases it should be applied as soon after the injury as possible.

In the light of my experience in a large number of cases, I will say that this method of treating depressed deformities of the nose is founded upon sound mechanical principles, and it aims at the ideal in surgery, namely, to restore the form and function of this organ by the replacement of its own tissues into their normal position.

TRANSPLANTATION OF BONE

The limitations of the bridge-splint operation first suggested to me the idea of transplanting bone for the correction of those deformities due to a deficiency in the bony framework, a class of cases for which hitherto little or nothing had been done. A living tissue was chosen for the reason that in the opinion of the writer the introduction of foreign bodies into the tissues for the correction of a nasal deformity still remains a procedure of unfixity. And the healing in and permanent retention of these bodies in a fixed and satisfactory position is a matter of considerable doubt. Furthermore, foreign bodies introduced into the tissues invite infection and they cause disintegration and absorption of the surrounding tissues.

In general, we may say that depressed deformities in which there is a deficiency in bony framework are suitable for bone transplantation. This deficiency may be due to—

1. Congenital defects
2. Traumatism, accidental or operative (submucous operations).
3. Abscess of the septum.
4. Destructive diseases, such as syphilis, lupus, and atrophic rhinitis.

The transplantation of bone into the tissues of the nose is an operation of extreme delicacy, and satisfactory results cannot be obtained unless the laws of antiseptics and asepsis are strictly observed. Infection destroys the life of the transplant and it either sloughs out at the time or is subsequently absorbed. Then too, if strong antiseptics are used during the operation, the cellular activity of the bone and the receiving tissues is impaired. After the first incision is made I use only physiological salt solution (9 gm to 1,000 ccm) freshly sterilized.

PREPARATION OF THE PATIENT

The patient should be in good physical condition. If the deformity is due to syphilis we must be sure that there are no active manifestations of the disease present, and that the Wassermann test is negative. If due to atrophic rhinitis the usual accompanying sinusitis should be attended to, and the hygiene of the nose improved as much as possible. Several hours before the operation the nose and face and the right side of the chest should be scrubbed with green soap and water, followed by alcohol and a wet bichloride dressing (1 to 5,000) applied. At the time of the operation the eyebrows are covered with collodion and both operative fields are painted with tincture of iodine.

The nose is first prepared for the reception of the transplant.

There are two points at which the incision may be made through which the tissues are elevated and the transplant introduced. (1) through a curved incision made between the eyebrows, (2) through an incision made from within the nose at a point corresponding to the lower edge of the upper lateral cartilage. Considerable discretion, however, should be exercised in selecting which method shall be used in a given case. The first method is preferable in the majority of cases; these include the most marked deformities and

those in which the nasal cavities are foul from old sinus suppuration

A curvilinear incision, convexity downward, is made between the inner extremities of the eyebrows through the skin and subcutaneous tissues down to the periosteum. Through this the tissues are elevated by means of a special sharp elevator over the entire nose, and in some instances, where there is considerable scar-tissue, far out under the cheeks. The semilunar flap is then lifted up and a short horizontal incision is made through the periosteum just below the glabella. At this point the bone itself is incised in order to excite an osteogenesis, which will unite the transplant to the frontal bone. The so called periosteum over the frontal bone is not an osteogenetic membrane, and is utilized in this operation merely to fix the upper end of the bone graft.

If the intranasal route is chosen, which may be done in cases of moderate severity and where the nasal cavities can be kept clean, the incision is made through the mucous membrane at the lower edge of the upper lateral cartilage and through this the tissues are elevated and the bone introduced. A pocket is also made toward the tip of the nose in which to place the lower end of the transplant.

The field, having been prepared for the reception of the bone graft, is covered with sterile gauze, and we then proceed to the next step in the operation, the removal of about two inches of the ninth rib on the right side. This is done with the costotome, the periosteum on the anterior surface only being preserved. This piece of rib is then split in its transverse diameter and the cancellous tissue scraped from the outer, periosteum-covered strip of compact bone. Recently I have attempted to imitate the shape of the nasal bones by making side wings to the dorsal strip of bone. This gives a better shape to the bridge and prevents the slight falling in which sometimes occurs on either side of the dorsal strip such as I have usually employed.

The transplant is then placed in its position in the nose, the lower end reaching nearly to the tip, and the upper end being anchored under the periosteum just below the glabella.

The blood-clot which has already formed in the wound is not expelled, for this nourishes the bone temporarily and later favors osteogenesis. The initial incision is then accurately closed with horse-hair sutures and a collodion-and gauze dressing applied. The sutures should be removed in three days.

In placing the transplant, either the convex or the concave surface may look forward, depending on the deformity. If the deformity is not corrected by one strip of bone, several pieces may be superimposed. If there is much scar-tissue, and especially if the deformity is extreme, lest the tension on the skin be too great, it is better to be content with establishing at the first operation a bony foundation firmly attached to the frontal bone upon which to build subsequently. At least six months should elapse before the second operation.

When all of the bony structure has been destroyed, and there is no support for the dorsal strip of bone, I support the latter by means of an inverted V-shaped pier made of two additional strips of bone, which rest on the superior maxillæ on either side of the nasal notch. In other instances I have used the bridge splint to support the transplant.

In one case I completely corrected the deformity by reversing the curves of two pieces of rib, the anterior strip being anchored under the periosteum over the nasofrontal process. The result in this case was particularly good.

In one case where the nose was absent, I first grafted the bone into the tissues of the arm, and at a subsequent operation grafted the flap containing the bone on to the face, when this had become united I severed the flap from the arm and shaped it into a fairly respectable nose through which the patient now breathes, and with which she is highly delighted.

Where only the cartilaginous dorsum is involved in the deformity, cartilage transplants may be used. These should be introduced intranasally. I have frequently used in these cases large bony or cartilaginous spurs removed submucously at the time the deformity is corrected. I have recently examined a case in which rib cartilage was transplanted two and one-half years ago.

The correction has been maintained and there has been no change in the size of the transplant, but it had not become fixed to the underlying bone.

The rib is selected for transplantation, as I stated in my first presentation of this subject, because it is suitable in shape, is conveniently located, its removal causes the patient little or no discomfort and it is quickly reproduced. Furthermore it is abundantly supplied with minute nutrient foramina.

The autoplasmic operation, i.e., the use of the patient's own tissue for transplantation, is preferable to all others because as I have previously pointed out, the constitution, i.e. the arrangement of the atoms in the molecule, is the same in both the transplant and the receiving tissues, so that there is no chemical antagonism between the two to interfere with the nutritive processes. These conditions would rarely be met save in the tissues of the same individual. I have tried bone from another patient on two occasions without success. I consider the autoplasmic operation the only one we are justified in doing.

The use of several small pieces of bone is preferable to large ones, for they are more easily nourished and besides small fragments possess relatively greater osteogenetic power.

When introduced into the tissues, each particle of bone is surrounded by a serous pabulum which nourishes it temporarily. This is followed by the development of new blood vessels from the surrounding parts and the proliferation of the osteoblasts contained in the transplant. In a case where I did a second operation, two years after the first transplantation, I found the original transplant securely imbedded in the tissues and covered by a firm periosteum.

Bone transplanted into the soft parts as into the nose, will give us a better idea of its individual characteristics than when it is used in filling in defects in the long bones, for in the latter situation it is being placed in its natural environment where its own characteristics will be confounded with those of neighboring tissues, namely, the periosteum and the bare ends of the injured bone.

The value of the periosteum[†] and the ultimate fate of the bone transplant are subjects which have received considerable attention from writers on this subject, and the wide divergence of opinion leads me to believe that much that has been written is based upon conjecture rather than clinical observation. Or else it is due to a difference in technique and in the local conditions in the operative field which may have affected the vitality of the transplant.

Bone is a tissue comparatively slow in its metabolic processes, therefore time is an essential element in estimating the changes that occur when it is transplanted into another part of the body.

My work in this field is, as far as I know, the first systematic effort made to correct nasal deformities by transplanting bone. Some of my cases therefore are of standing long enough to enable one to draw conclusions. Furthermore, all of my work has been done upon human subjects and many of the cases have been under constant observation, so that conclusions drawn have direct practical value, and they are based upon historical facts and not upon prophecy, which would be the case if sufficient time had not elapsed since the operation, or if our experience had been limited to animal experimentation.

I have transplanted bone both with and without periosteum, and my oldest cases are of over five years' standing. A detailed account of these cases would serve no useful purpose, I will therefore offer the following conclusions which are drawn from clinical observation and from repeated X ray examinations. In my opinion they show the true status of autoplasmic bone transplantation.

If the wound becomes infected, the transplant may be expelled at once. If the infection is controlled by prompt and efficient means the transplant is probably dead and will in time be absorbed. But if the deformity was properly corrected it will remain so, as the absorption of bone is a slow process and it is replaced by connective tissue, cartilage, or bone which maintains the correction.

When live bone is properly and aseptically transplanted the results are as follows:

1 Bone *with or without periosteum* and free in the soft tissues is osteogenetic and also probably acts in an osteo-inductive capacity.

2. Bone uncovered by periosteum when connected with live, periosteum-covered bone is osteoconductive and osteogenetic, the points of greatest growth being where it comes in contact with the periosteum.

3 A periosteum-covered transplant connected with live, periosteum-covered bone establishes a firm bony union with the latter in three weeks, and it continues to live and grow practically unaffected by its change in environment. I have as yet noticed no

overgrowth in such transplants and I believe that their development is regulated by the physiological requirements of the part.

While the periosteum is not necessary for the preservation of the transplant, it certainly adds to its vigor and growth and contributes to the success of the operation. In view of my experience in these cases I can not subscribe to Macewen's views, that the periosteum is merely a limiting membrane and that it has no osteogenetic function.

In conclusion I will say that the transplantation of bone offers a very satisfactory means of relief for a class of nasal deformities for which hitherto little has been done.

BLOOD-PRESSURE IN FIBROMYOMATA UTERI

By HOWARD C. TAYLOR, M.D., F.A.C.S., AND WILLIAM C. WHITE, M.D., NEW YORK

THE literature on the relationship between fibromyomata of the uterus and the circulatory system is abundant, but a careful search showed only one reference to the blood-pressure found in these cases. Barrows (1) found that "none of these patients as a rule had a high blood-pressure and that the blood pressure was practically not changed by the removal of the tumors themselves nor by the uterus together with the tumors." However, he gives no records on which he bases his conclusions. An investigation has therefore been made of the recent records of the Roosevelt Hospital Gynecological Division to see if any information could be obtained.

We took 148 consecutive cases of fibromyomata of the uterus in which blood-pressure had been taken. These embraced the years 1913 and 1914 and the first few months of 1915. A number of cases were found to be clearly cardionephritic and so were excluded. Of the 148, 53 (37 per cent) had a brachial blood-pressure of 120 mm. Hg. or under, with an average age of 34.9 years, and 62 (41.8 per cent) had pressures from 121 to 140 mm. Hg. inclusive, with an average age of 35.8 years. This made a total of 117 cases (78.8

per cent) with a blood-pressure of 140 mm. or under, and an average age of 35.9 years. As these cases were thought to be normal variations, only the remaining were given further study.

The 31 over 140 mm. blood pressure had an average age of 43 years. Letters were sent to these patients, and as a result, 22 came to see us. Most of the 22 had large fibroids, and at operation these tumors were removed while in most cases either a supravaginal or a complete hysterectomy was performed. On return, the patients had general physical and pelvic examinations, urine analyses, and brachial blood pressures.

FINDINGS

1 Urine. Hyaline casts were found in one specimen, a trace of albumin in two other cases, while in a fourth case the family physician has found traces of albumin several times since operation. A fifth case gave Fehling's reduction.

2 In the cases having high blood pressure slight cardiac enlargement was usually found, but only in the glycosuria case was there heard a murmur.

3 Three cases had unchanged blood-pres-

Hospital Number	Date of Discharge	Examination Date	Hospital Blood-Pressure	Examination Blood Pressure	Age	Urine	Heart Etc	Pathology Operation
1441	6-10-13	5-1-13	130	140	31	Negative	Negative	Several small fibroids. Myomectomy
1633	8-4-13	4-16-13	165	190	43	Negative	Negative	Grape fruit size Supravaginal hysterectomy
1638	8-6-13	5-1-13	190	235	47	Bilaine casts	Large heart oedema dysp	Large intramural Complete hysterectomy
1639	8-7-13	5-25-13	145	160	45	Negative	Negative	few small fibroids Myomectomy
1705	10-14-13	4-16-13	150	160	39	Albumin faint trace	Negative	Multiple fibroids Supravaginal hysterectomy
1811	11-17-13	5-13-13	165	150	50	Negative	Negative	Many fibroids Complete hysterectomy
4044	3-9-14	4-15-13	190	253	40	Albumin faint trace	Negative	Many fibroids Supravaginal hysterectomy
4717	5-13-14	4-14-13	150	170	45	Negative	Negative	Many fibroids Supravaginal hysterectomy
4721	11-13-14	4-19-13	145	140	38	Nephritic history	Negative	Several submucous. Supravaginal hysterectomy
4391	10-14-14	4-11-13	130	140	43	Negative	Negative	Many large fibroids Supravaginal hysterectomy
4612	10-5-14	4-16-13	150	150	45	Negative	Negative	Large intramural Supravaginal hysterectomy
468e	11-13-14	4-11-13	150	170	44	Negative	Negative	Moderate size Supravaginal hysterectomy
4387	10-11-14	4-15-13	165	160	36	Negative	Negative	Large fibroids Supravaginal hysterectomy
4677	11-11-14	5-3-13	175	190	49	Negative	Negative	Several fibroids Supravaginal hysterectomy
4860	1-11-15	4-14-13	160	165	33	Negative	Negative	Many fibroids. Complete hysterectomy
4641	1-15-15	4-16-13	155	180	46	Holding a positive	Systolic et apex	Many large fibroids Supravaginal hysterectomy
4829	1-10-15	4-15-13	155	160	40	Negative	Negative	Many intramural Supravaginal hysterectomy
3537	6-11-15	6-3-13	160	160	31	Negative	Negative	12 walnut size Myomectomy
4059	3-7-15	5-27-13	145	170	57	Negative	Negative	Many fibroids Complete hysterectomy
4044	3-15-15	6-4-13	145	145	56	Negative	Negative	Several intramural Complete hysterectomy
5006	3-10-15	4-15-13	195	155	30	Negative	Negative	Many fibroids Supravaginal hysterectomy
5011	3-11-15	4-22-13	145	135	36	Negative	Negative	Many large fibroids Supravaginal hysterectomy

sure, 11 had an increase from 5 to 65 mm, and 8 had a decrease from 5 to 40 mm Hg

We therefore find—

1 That no definite relation is shown between fibroids and increased blood pressure

2 That the removal of the tumor or the tumor with the uterus, has no definite effect in those cases which happen to have an increased blood pressure

REFERENCES

- 1 BARROWS Am J Surg N Y, 1912, xxvi, 161
- 2 PAYNE J Am Med Ass, 1913, lvi, 1324
- 3 MCGLENN N Y M J, xxi, 1085
- 4 BOLDT N Y M J, lxxii, 887
- 5 DOANE Surg, Gynec & Obstet, 1912, xiv, 4
- 6 BISHOP J Gynec & Obst, Brit. Imp., xvii, 270
- 7 WILSON Lancet, Lond., 1906, Part 2, 1425
- 8 MCGLENN Surg, Gynec. & Obst., 1914, xviii, 180
- 9 JASCHEK Zentralblatt f d Grenzgeb d Med u Chir., Jena 1911, xvi, 249

THREE HUNDRED TWENTY-FOUR CONSECUTIVE CASES OF APPENDICITIS, OPERATED UPON WITHOUT A DEATH

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IN a period of four and one-half years, January, 1911, to July, 1915, there have been operated upon at the Naval Hospital at Norfolk, Virginia, 324 consecutive cases of appendicitis without a death. Practically all these cases were operated upon either by Dr. H. F. Strine of the Navy, by the writer, or by some other member of the hospital staff under their supervision. In this series there have been 183 acute cases and 141 cases classified as chronic. Under the acute cases are included the commonly recognized varieties of the acute catarrhal, acute suppurative, gangrenous, and perforative types. Cases with abscess formation are also included under this head. Under chronic cases are included the interval operation cases, the so called relapsing and recurrent types, and also that considerable class whose symptoms are referred almost entirely to the stomach and which are not infrequently diagnosed as ulcer. Under this head also are included that not uncommon class of cases now recognized as chronic intestinal stasis due to partial obstructions produced by adherent appendices or by adventitious bands and membranes in the region of the appendix. In this latter class appendectomy has always been done in addition to plastic correction of obstructions produced by such membranes and bands. For this reason these cases are included under the head of chronic appendicitis.

A great majority of the acute cases reached the hospital early, but in many cases an early transfer was not possible. Cases occurring on the smaller cruisers, torpedo boats, in the submarine flotillas, and on sea-going tugs, when such vessels are at a distance from port, cannot, in the nature of things, be transferred to the hospital for many hours or days after the diagnosis has been established, and such vessels do not afford facilities for operat-

ing. Acute cases occurring on the larger vessels under similar circumstances are commonly operated upon on board as soon as a diagnosis is made. We have been fortunate in not losing any of these late cases but attribute this result largely to the fact that in nearly every case an early diagnosis was made and food and purgatives were withheld from the beginning. In other words, in practically all those cases that could not be transferred to the hospital at once the Ochsner treatment was instituted early and faithfully carried out. The fact that in this entire series there have been no residual abscesses except moderate collections of pus in the immediate vicinity of the wound of operation not requiring secondary incisions for their evacuation, goes to show that there has not been any great amount of diffusion of the infection through the setting up of excessive peristalsis.

Of the 183 acute cases, 28 were drained, 9 for gangrene of the appendix, 12 for a more or less diffuse peritonitis, and 7 for abscess. In 2 of the abscess cases the appendix was not removed.

Every case presenting acute symptoms has been operated upon as soon as the patient and operating room could be prepared. The preparation of the patient in these cases consists of the giving of a single low enema and of dry-shaving the skin, or shaving with the use of alcohol, if preferred. Nitrous oxide and oxygen has been the anæsthetic in the great majority of the cases or these two with the aid of ether, especially in alcoholics. The skin is painted with benzine and, when this has dried, with a 2.5 per cent tincture of iodine. The McBurney incision has been employed almost to the exclusion of any other. Occasionally the ordinary McBurney incision has had to be enlarged by opening the sheath of the rectus muscle. By opening

the rectus sheath obliquely upward or downward as conditions indicate, an opening of sufficient length for all purposes may be obtained. In a small number of cases the Battle incision has been used, drawing the muscle toward the midline.

The appendix has been removed in all cases except two of the abscess cases. For the past year and a half we have not inverted the stump, believing it entirely unnecessary. The meso appendix is tied off, usually with a single ligature, the base of the appendix is clamped, ligated with No. 2 chromic catgut in the groove thus formed and the stump disinfected with carbolic acid. In several cases in which a secondary operation had to be done for other causes it was found that no sign of the stump was present and no adhesions had been formed following simple ligation. It is apparently of the greatest importance after the use of iodine to cover the skin around the incision with tetra cloths or towels, fastening these to the margin of the incision with appropriate clamps. In a number of clean cases in which this precaution was not taken, we have seen post operative adhesions which required secondary operation. We believe the contamination of exposed intestine with the tincture of iodine to be a fruitful source of such adhesions.

In cases of gangrene the appendix is always removed and an attempt is made to completely bury the stump with Lembert sutures of catgut, taking care to insert the stitches in the healthy wall of the cæcum. In such cases a cigarette drain is always employed.

In all drained cases non absorbable sutures should never be used, for such material is not infrequently the cause of persistent sinuses.

In cases with local or diffuse peritonitis the pus that presents itself in the wound is quickly mopped out with gauze on sponge holders, the appendix crushed, ligated, and cut away and one or more cigarette drains inserted. No attempt is made to wipe off the intestine or to cleanse any part of the peritoneal cavity except that in the immediate vicinity of the wound. No irrigation with saline peroxide of hydrogen, or other fluid is attempted. One drain is usually inserted toward the pelvis and a second to the base

of the appendix. These cases stand prolonged operations badly, the quicker the operation, other things being equal, the better chance the patient has for recovery. The kind of drain does not seem to be a matter of great importance. For the past year and a half cigarette drains have been used exclusively, but prior to that soft rubber drainage tubes were employed. The cigarette drains are commonly left in place four or five days without being disturbed, depending upon the severity of the case. Drainage tubes are always removed within forty-eight hours and another tube or wick inserted if necessary. If left in place for longer than forty-eight hours or thereabouts drainage tubes not infrequently cause pressure necrosis and fistula. In cases in which the omentum is extensively thrombosed and discolored, that portion of it thus involved is ligated in sections and removed. We have been fortunate in having no case of pyelophlebitis in this series and we have also been fortunate in having no residual abscesses except in the immediate vicinity of the wound of operation. All such abscesses have been opened by simply enlarging the wound and gently exploring with the finger. In one case complete intestinal obstruction developed on the thirteenth day. An enterostomy was done through a secondary rectus incision, a large catheter inserted into the distended intestine according to Kader's method, the end of this catheter led out through the original incision, and the rectus wound closed. The patient recovered without fistula and without the necessity of further operation.

Drainage is being employed much less frequently now than three or four years ago. Cases in which the inflammation is confined to the appendix, even those with extensive plastic exudate and moderately turbid fluid are not drained. We have had no occasion to regret the omission of the drain in such cases.

In operating upon cases in which abscess has formed, the McBurney incision is commonly used. This incision not infrequently has to be enlarged by opening the rectus sheath. The abscess is carefully walled off with gauze and gently opened. Not infrequently a conglomerate mass of intestine and omentum presents itself, to which there

seems to be no head or tail. By boring into this with the finger, thus opening the abscess, and mopping away the pus with gauze, the various elements can be identified and the appendix removed in a great majority of cases. In most of these cases and in many of the acute suppurative cases without abscess formation, the appendix can be gently dug out of a mass of adhesions without paying any especial attention to its mesentery, for in a large percentage of these cases the vessels of the meso appendix are thrombosed and do not require ligation. After the abscess cavity has been thoroughly cleansed, two or three cigarette drains are inserted, the protecting gauze pads removed and the wound is partially closed.

In all acute cases, especially those in which drainage is to be employed, it is of great importance to make the incision as small as is consistent with thorough work, and in these cases the muscle splitting incision is of special advantage in order to avoid post-operative hernia or weakening of the abdominal wall. In these cases the muscles and other elements of the abdominal incision should be protected from infection in so far as it is possible. Before closing the wound it is well to swab it thoroughly with tincture of iodine. In some especially virulent cases we have applied carbolized vaseline to the wound with apparent benefit. In that the not uncommon sloughing of fascia and muscle seemed to be prevented or lessened thereby.

In all acute cases, especially those requiring drainage, the post operative treatment is of the greatest importance. Except in the mildest cases nothing is given by the mouth for twenty four hours, when sips of hot water are allowed if everything is going well. At the end of thirty six or forty-eight hours an enema is given. Purgatives are avoided for several days at least.

All cases with any degree of peritonitis are placed in the Fowler position upon reaching the ward, and protoclysis by the Murphy drip begun. The saline is allowed to flow very slowly, drop by drop, and is continued until 1,500 or 2,000 cubic centimeters have been absorbed or until it is beginning to be expelled. Nothing is allowed by mouth in the

severer cases until peristalsis has become reestablished and abdominal distention has disappeared. This may require several days, and in the meantime protoclysis is continued.

If vomiting occurs, or if for any reason the patient does not seem to be doing well, the stomach is washed out until the fluid returns clear and this procedure is repeated as often as may be necessary, occasionally being done four or five times in twenty-four hours. If distention and absence of peristalsis persist, repeated enemas are given, each containing one or two drams of turpentine. Such enemas may be given every hour for five or six hours, and after a rest of a few hours this course may be repeated if necessary. By persevering in this treatment recovery will frequently ensue when almost despaired of.

The recovery of the 183 consecutive cases of acute appendicitis herein reported is attributed to the following factors:

1. Early diagnosis and early transfer to hospital in a very large proportion of cases.

2. The avoidance of food, drink, and purgatives, especially the latter (the Ochsner treatment), in a large percentage of the cases that could not be immediately transferred.

3. Immediate operation in all cases presenting acute symptoms and in every case in which the acute symptoms had suddenly subsided.

In contrast to the small incision employed in the acute cases the incision in the chronic cases should always be of ample size to permit a thorough exploration, not only of the region of the appendix but of the caecum, the ascending colon, and the terminal portion of the ileum as well.

It is now definitely established that many cases which were formerly diagnosed as chronic appendicitis are not due to inflammation of the appendix but to chronic obstructions of the terminal ileum or of the ascending colon by certain adventitious bands and membranes. To properly correct such conditions incisions of considerable length are necessary. A four or five inch vertical incision to the right of the umbilicus, displacing the rectus muscle outward, seems to fulfil all requirements. Such an incision may be easily extended upward or downward as indicated.

DEPARTMENT OF TECHNIQUE

A METHOD OF DEMONSTRATING BACTERIA IN URINE BY MEANS OF THE CENTRIFUGE

WITH SOME OBSERVATIONS ON THE RELATIVE VALUE OF EXAMINATIONS BY CULTURE OR STAINED SEDIMENT¹ AND ²

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WITHIN the past year my attention has been called to the value of stained urinary sediments as a control to cultural evidence in the diagnosis of urinary infections. Obvious lack of correspondence between the clinical picture of urinary infection and repeated negative cultures from the urine indicate that routine cultures made on a single variety of media may be misleading. A large bacterial flora is known to exist in urine. Many of these bacteria require for cultivation special media and anaerobic conditions not provided by routine cultural methods. To be sure many varieties of bacteria found in urine are not pathogenic, yet the fact remains that our knowledge of their significance is limited.

It is with the hope of presenting a simple method of demonstrating the presence of bacteria, including the tubercle bacillus, in the urine, and of emphasizing the clinical importance of stained preparations made directly from the urine as a control to routine cultural examination, that this communication is made.

Numerous methods of demonstrating tubercle bacilli in excretions of the body have been devised. One hesitates to add to the list since guinea pig inoculation must be considered the final test in all doubtful cases. Guinea pig inoculation, however, necessitates a delay, which, in some instances, may be insignificant, but which in others often allows time for the appearance of lesions in other organs of the body, particularly in the genital organs in males.

¹ Dr. A. E. Steele of the Pathological Laboratory of the Massachusetts General Hospital called my attention to overgrowth of other bacteria by bacillus coli occurring in mixed infections of the urine. This occurrence leads to the finding of a profuse matting growth of this organism in the majority of mixed cultures. Within the present year (1915) Schmidt and Linsgaugen (*Zeitschrift med. Bacteriologie* 1915: 1, 278) and 1912 and Munneberg observed that bacteria are found more frequently in smears from sediment than in cultures from the urine.

² As far as I know the method here described of concentrating bacteria by discarding pus from urine is original. It was suggested by observing Dr. J. H. Wright separating blood platelets from blood by means of the centrifuge.

When one considers the extreme rarity of negative findings from guinea-pig inoculation where a tuberculous lesion exists in the kidney, and the comparatively small amount of urine commonly injected into the pig, he is convinced that tubercle bacilli must be present in the urine in sufficiently large numbers to enable him to arrive at an immediate diagnosis were it possible to concentrate the bacilli in a sufficiently small sediment. In the Massachusetts General Hospital we inject twenty minims of non-centrifuged urine in making guinea pig inoculations for tuberculosis. In those cases in which repeated inoculations have been made from the urine of the same patient, lack of agreement in results has been extremely rare. One marvels at the accuracy of the test and likewise at the ability of the pig to produce the evidence even though no effort is made to concentrate bacilli in the urine injected. The urine from patients with tuberculous renal lesions must be generously and quite uniformly laden with tubercle bacilli.

The chief obstacles to the demonstration of tubercle bacilli in urine, by staining methods, are pus and detritus and the density of the bacillus. Tubercle bacilli are of almost the same density as urine. Only those bacilli which are entangled in shreds of mucus or are swept down by pus cells are to be found in sediments obtained by the ordinary centrifugalization, the majority of the bacilli are left floating in the urine above.

By taking advantage of this marked difference in density between tubercle bacilli and pus it is possible to concentrate the bacilli contained in a considerable amount of urine into a small sediment, in cover-glass preparations from which bacilli will be found in large numbers unmasked by any considerable number of cells.

The procedure is simple but requires a first class centrifuge, preferably an electric centrifuge

such as is used in blood work. A less powerful machine may be used but this necessitates a much longer time to throw down the bacteria. In the larger hospitals a suitable high power machine is usually available.

My technique is as follows: If the urine contains considerable pus, centrifuge for one to two minutes at the lowest speed. The bulk of the pus and detritus will be thrown down in a heavy sediment leaving a somewhat cloudy urine above containing a few pus-cells and the majority of the bacilli. Decant the urine into a clean tube, discard the sediment, and centrifugize the urine at high speed *until it is clear*. This step requires 15 to 30 minutes. The urine may be then decanted and the tube containing the sediment refilled with partly clarified urine and replaced in the centrifuge. In this way the contents of two or more tubes of urine may be concentrated into a single small sediment. Pour off the urine, invert the centrifuge tube on a towel and drain off the last drops. A fairly dry small sediment will be obtained which can be removed with a loop, and cover-glass preparations made, or cultures planted.

In those urines which contain but little pus, experience has shown that preliminary centrifugization is unnecessary. The important step in the procedure is to centrifugize the urine *until clear* to ensure deposit of the bacilli.

By the above method tubercle bacilli can be obtained from the urine in practically all patients with renal tuberculosis in numbers sufficient for diagnosis, and in most cases in surprisingly large numbers. This is especially true where the specimen of urine is obtained from the pelvis of the kidney. In examination of bladder urine it is advisable to concentrate the bacilli from more than one tube of urine into the same sediment since tubercle bacilli are apt to be present in bladder urine in smaller numbers than in urine from the diseased kidney on account of dilution by urine from the actively secreting sound kidney.

The danger of mistakes in diagnosis arising from any method of demonstrating tubercle bacilli by staining in sediment must be remembered. The chief danger is contamination from the smegma bacillus, which may inhabit the deep urethra in the male and the anterior portion of the urethra of the female. There is little evidence to indicate that this bacillus is ever present in the bladder except as accidental contamination carried there by the catheter.

The number of organisms to be found in the

bladder urine from this source is necessarily small and negligible where large numbers of tubercle bacilli are demonstrated, as is done in the procedure just described. The smegma bacillus is not an inhabitant of the renal pelvis and the chance of accidental contamination at this remote distance is inconsiderable.

My experience with the centrifuge as the means of demonstrating tubercle bacilli, over a period of nine months with a total of 55 cases, has been satisfactory. The findings have been controlled by guinea-pig inoculation. I have dealt only with catheter specimens or urine from the bladder or from the kidney. I have made no erroneous diagnoses save in two abnormal renal conditions with tuberculous abscess formation which had not entered the pelvis of the kidney. Guinea pig inoculations were also at fault in these cases. In two other instances I have been compelled to withhold an opinion even though a few acid fast bacilli were found. A guinea pig inoculated from the unused portion of the sediment showed tuberculosis in one of the two cases. In the other case no diagnosis could be made, either from stained sediment or guinea pig inoculation at the time the patient was seen. Three sets of guinea pigs which had been inoculated from right, left, and bladder urine showed disagreement. At the first inoculation the pigs from bladder and both ureters were negative. At the second inoculation the bladder was positive and both ureters negative and finally the left ureter was positive and the bladder and right ureter negative. Tubercle bacilli were found once in three attempts from the bladder urine. At the end of six months the patient returned with a definite picture of left renal tuberculosis. Large numbers of bacilli were found in the urine from the left kidney. The diagnosis of left renal tuberculosis was made and confirmed at operation.

In a similar way, the absence of tubercle bacilli in urine obtained from the supposedly sound kidney has been confirmed by guinea-pig inoculation in all cases examined to date.

A second possible source of error which must be borne in mind in urinary examinations by staining methods is the centrifuge tube. The tubes used should be above suspicion of containing acid fast organisms derived from any source of contamination. The two chief sources of such contamination are reagents used including water and the use of a centrifuge tube in which a tubercle bacillus-laden urine has previously been examined. In as much as there is no occasion to wash sediments in the above-described method

the centrifuge tube is the only element of danger worthy of consideration. I thoroughly cleanse the tube with water and a cotton swab, rinse in concentrated sulphuric acid, then with water and dry the tube with a sterile sponge. If carefully done this cleansing is sufficient.

In performing the Ziehl-Neelson stain the cover-glass preparation should be decolorized by exposure for 30 seconds to 30 per cent nitric acid followed by alcohol. Tubercle bacilli will not be decolorized by this treatment if the carbol fuchsin stain has been well fixed by steaming for two minutes, while other acid fast bacilli will not resist the strong acid.

I wish also to emphasize the value of stained sediments in the diagnosis of non-tuberculous infections of the urinary tract. Bacteria can be obtained from infected urines in large numbers by first removing the pus through throwing down the bacteria by centrifugalization of the urine at high speed until the urine is clear. By performing the gram stain, and the Ziehl-Neelson where indicated, the presence of infection is immediately determined and sufficient information as to the varieties of bacteria present is obtained to indicate proper cultural procedures. Contamination is immediately recognized as distinct from infection by the number of bacteria obtained.

The clinician is frequently struck by obvious inconsistencies in cultural reports from repeated examinations of the same patient's urine. This lack of conformity is the result of a number of factors over which the bacteriologist has no control, unless sufficient urine and time to make extensive cultures on a variety of media are at his disposal. The most important of these factors are (1) Unsuitable media and anaerobic requisites, (2) the presence of formalin in instruments, (3) chromogenic properties of certain bacteria, and (4) overgrowth.

The marked tendency of certain varieties of bacteria to overgrow other forms is well known. The colon bacillus is the commonest offender in this direction. The result is often a report from the bacteriologist of a predominant growth of bacillus coli when the predominant organism in the fresh bladder urine may not be that organism. An instance of the occurrence of this error is a patient recently operated on at the Massachusetts General Hospital by Dr. Hugh Cabot. The patient had had recurrent phosphatic calculi in the bladder. His physician insisted that the urine had been constantly acid in reaction although one would expect a coccus infection in an alkaline urine with recurrent phosphatic calculi.

The urine was stated to be acid in reaction and cultures had been reported as showing a growth of bacillus coli. When the patient entered the hospital his urine showed acid reaction in a specimen which had stood six hours, and cultures were reported as a predominant growth of colon bacilli. Freshly passed urine, however, was alkaline and stained sediments showed a mixed infection of staphylococci, streptococci, and gram-negative bacilli with the cocci predominating. The stone was crushed. The urine acidified with cultures of bacillus bulgaricus and at the end of ten days the bladder was free from encrustations.

Relatively unimportant chromogenic bacteria such as bacillus pyocyaneus, a transitory infection of the urinary tract of low pathogenicity, often, by the color of the colonies and the rapidity of growth obscure more significant permanent infections.

Unsuitable media or lack of anaerobic conditions may result in a failure to recognize some of the more rare varieties of bacteria occasionally met with in urinary infections. A stained sediment will show the presence of bacteria and proper cultural proceedings can be taken.

Braasch has emphasized the possibility of formalin sterilization of small amounts of urine obtained through ureteral catheters which have been sterilized by formalin. Sufficient of the antiseptic is washed down from the catheter to inhibit growth in cultures. I have also observed instances of no growth in cultures taken from bladder urine, in cases where hexamethylenamine has been used, but infections were demonstrated by cultures from the urine obtained from the kidney pelvis.

I do not wish to be understood to imply that cultural examination of the urine in infections is of less significance than the evidence produced by cover glass preparations from sediment. Stained sediments serve to distinguish true infections from contaminations, show something of the nature of the infecting bacteria, show the predominating organism in mixed infections which is not accurately demonstrated by cultures in some cases, and demonstrate the presence of unusual bacteria which are not found by routine cultural examinations.

There is an interesting group of the more rare forms of bacteria, particularly anaerobes, to be found in urine. Little is known about their significance as infecting organisms in the urine. I have met with many such varieties of bacteria either alone or in mixed cultures and often in

association with tubercle bacilli. There can be no doubt that the colon bacillus is by far the most common and important organism concerned in infections of urine, yet its frequency of occurrence is overestimated by many clinicians and in many

cases other varieties of organisms are overlooked. A step will be made toward specific treatment of urinary infections when other forms of bacteria are recognized and their pathogenicity in the urinary tract determined.

ARTIFICIAL LEVERAGE IN THE REDUCTION OF FRACTURES

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THERE are some fractures that are fairly amenable to reduction by the unaided hands of the operator if advantage be taken of muscle balance and the natural leverage provided by the neighboring parts of the skeleton; there are others in which, because of dense edema, impaction, or muscle pull, those means, unaided, are no more good than faith healing. Some of the latter type of fractures will be mentioned in this paper and a description will be given of the few simple but efficient instruments used and the technique employed, as evolved from the author's experience as a fracture surgeon.

The clamp (Fig. 1) is like the common quilting clamp, but with a six to ten inch jaw of malleable iron, and if one be not too particular regarding appearance, may be obtained at any well stocked hardware store. The other pieces shown in Fig. 1 (b, c and d) are wood; the pad

pieces suitably grooved and beveled to prevent injury of the soft parts, and in emergency can be easily made by anyone. In use the clamps are padded with cotton or sheet wadding.

Perhaps the matter may best be made clear by a few typical cases.

CASE 1. Cracking a long bone. W. G., age 6, fell while roller-skating, sustaining the injury depicted in Fig. 1. For nearly three weeks he was under the care of a physician who kept telling the mother that the deformity was due to a swollen muscle which would soon subside. Finally the mother became thoroughly alarmed and took the lad to her family physician, Dr. Stewart H. Bens, through whose courtesy he came under the writer's observation. On the twentieth day after injury, the technique shown in Fig. 2 was used under anesthesia, with the result shown in Fig. 3.

The cases of fracture near the elbow joint, so commonly seen in children, are in the writer's experience almost invariably separations, more



Fig. 1

Fig. 1. X ray showing fracture of long bone. Case 1.

Fig. 2. Showing technique used to correct deformity.

Fig. 2

Fig. 3. Shows the result of applying the technique shown in Fig. 2.

Fig. 3



Fig 4



Fig 5



Fig 6



Fig 7

Fig 4 Fracture at elbow joint, Case 2

Fig 5 Radiograph one week after injury and reduction deformity scarcely affected

Fig 6 Shows technique of reducing fracture at the elbow-joint

Fig 7 Result of procedure



Fig 8

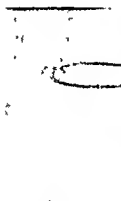


Fig 9

Figs 8 and 9 X rays showing fracture in Case 3



Fig 10



Fig 11

Figs 10 and 11 show result of reduction

or less pure, of the distal epiphysis of the humerus. Some are incomplete, others, complete, are not displaced, others, displaced, especially if seen early, say within an hour or two, are fairly easy to reduce, others may be exceedingly difficult, as in Case 2.

CASE 2. *Lower end of humerus.* J. W. age 3, patient of Dr F. L. Scanlan, fell short distance on July 1, sustaining the lesion seen in Fig. 4. After 24 hours the entire elbow region was greatly swollen and had the consistency of India rubber. The skeleton was nowhere palpable. The doctor and I tried strenuously to effect a reduction under chloroform, and as the case resembled closely several others in which good results had been obtained with no greater effort, overconfidence overruled caution and no confirmatory radiograph was made at the time. A radiograph taken a week later, however, owing to the persistent swelling and deformity, showed that the displacement had been scarcely affected (Fig. 5). On



Fig 12 Shows technique used in reducing Colles fracture Case 3

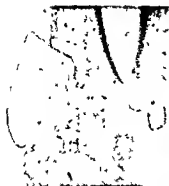


Fig. 13



Fig. 14



Fig. 15

Fig. 13. Upper fracture lateral displacement Case 2.
Fig. 14. Showing application of clamps.

Fig. 15. Result of application of clamps for reducing the fracture.

July 8, eighth day, the technique illustrated in Fig. 6 was used under anesthesia, with the result shown in Fig. 7.

CASE 3. "Lower fracture backward displacement." H. G., age 9, a very fat little girl was struck by a motorcycle on May 8, receiving a fracture of the tibia as depicted in Figs. 8 and 9. Three separate attempts, under an anesthetic had been made by conventional and skillful general surgeons to reduce this fracture. On the twelfth day after injury, she was again etherized and the tech-

nique shown in Fig. 11 was used. The results are seen in Figs. 10 and 11. Considerable maneuvering was necessary to detach the almost solidly healed fragment but as it could be shifted over into place, no harm was done the soft parts.

CASE 4. "Lower fracture lateral displacement." H., age 21, patient of Dr. W. J. McNamara, on December 6, 1914, fell from wall 40 and received the fracture shown in Fig. 12. Reduction had been attempted under ether at one of the largest Syracuse hospitals, of which the mem-

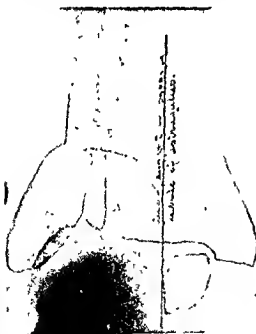


Fig. 16. Shows Pott's fracture Case 5.

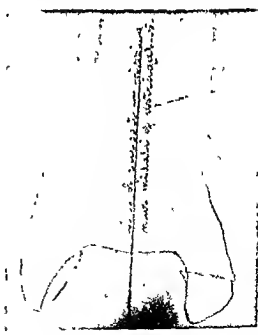


Fig. 17. Shows result of application of clamps Case 5.



Fig 18 Shows application of clamp Case 5

bers of the staff rank high as general surgeons but the persistent pain and deformity were so severe that the patient left the hospital and consulted Dr. McNiemy. A radiograph (Fig 13) made at this time (ninth day) showed the radial fragment displaced half a diameter the ulnar styloid a full diameter outward. Under either the clamps were used as in Fig 14. The results are shown in Fig 15.

The distal fragment in Colles' fracture while being forced home in either direction, shows a queer tendency to sheer off at right angles to the plane of procedure. To develop this point with illustrative cases might make this paper unnecessarily tedious but it is well to state that this aberration should be forestalled by a second clamp tightly placed at right angles to the plane of reduction, as illustrated in Figs 12 and 14.

CASE 5. Potts' fracture. Mrs. M. age 72 patient of the Drs. Van Lengen on February 15 by a slight misstep sustained the lesion shown in Fig 16. Six hours later she was anesthetized and reduction was attempted by Dr. Frederick W. Van Lengen who weighs 265 and is one of the strong men of the Syracuse Turn Verein. The radiograph (Fig 16) made next day discloses plenty of rea-

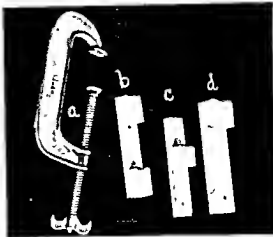


Fig 19 a Common quilting clamp, b, c, and d, grooved and beveled wood pad pieces

son for the difficulties encountered! The inner malleolus, carried a full diameter outward, had engaged in the ankle mortise formed by its undetached base. On the second day after injury, the technique illustrated in Fig 18 was applied under chloroform, when with strong traction and abduction of the foot by Dr. Warner Van Lengen, one good twist of the clamp accomplished the results seen in Fig 17. By further study of the original radiograph (Fig 16) it is seen that in the uncorrected position of the bones, the line of support falls entirely within the astragalus. It is quite evident that this dear old lady could never have walked again, on such an ankle without the support of crutches. As the case eventuated she was walking unsupported at the end of four weeks, and now I am told has no soreness and no lump. Life has some satisfaction—for even a bone-setter.

No accident in the use of this technique has occurred yet in the writer's experience. Like every other therapeutic agent powerful enough to be capable of good, however, this clamp, if used with brutal disregard of the anatomical proprieties, is doubtless capable of harm. Used judiciously it seems to offer a means of attaining results impossible without it.

SURGICAL TREATMENT OF ACUTE GONORRHOEAL TUBE INFECTIONS WITH A QUARANTINE PACK¹

By ROBERT C. CONLEY, M.D., F.A.C.S., PORTLAND, ORE.

As an interne in the Louisville Hospital in 1895 and 1899, I noticed that more than half the number of patients in the female surgical ward were there for gonorrhoeal tube infections. A considerable percentage of them were in the acute stage, and all were treated by immediate operation with a mortality of more than 30 per cent, although a drainage tube was used. One surgeon, however, did the very radical operation of total vaginal hysterectomy for pus tubes, with very low mortality compared to the others, so when I left the hospital and engaged in the private practice of surgery, I followed the operator who had had the smallest death rate, and my first fifteen operations for pus tubes had but one fatality. About fourteen years ago my attention was called to Price's coffee-drum gauze drain, by which it was unnecessary to sacrifice the uterus. This pack of gauze practically removed the mortality of these cases. The drains were removed about the fourth or fifth day and the wound repacked. As a result, from 25 to 50 per cent of the patients developed hernie afterward. About ten years ago I began to protect the coffee-drum drain with a sheet of rubber tissue placed above the gauze, thus preventing the intestines from coming in contact with the gauze. This was a decided improvement but I still removed the drains too early, including the rubber, and still continued to have a considerable number of cases of post-operative hernia. Gradually I learned that the longer the drains were left (and particularly if the wound was not repacked afterward), the less likely the patient was to have a hernia, until finally by evolution we worked out the plan we now have which will be described later, and which is practically without post-operative hernia.

If for the most striking feature that we have noted in opening these abdomens for other conditions later, is the absence of post-operative adhesions. In a paper before the American Medical Association two years ago I called attention to the use of the protected quarantine pack for the treatment of abdominal adhesions, which is the only way I have ever been able to completely cure persistent abdominal adhesions in a certain class of cases which we may call adhesion formers. We have used this drain for the purpose of quarantining a septic uterus following

abortions, and even in puerperal sepsis as well as in all other forms of tubal infections. In tubal infections following pure infections of the uterus we have not for some time removed the tubes in young women, but have slit the tubes and used the quarantine pack in most cases. These cases heal up without a sinus. On the contrary, gonorrhoeal pus tubes treated in the same way, after the ends of the tubes have been sealed, have resulted in sinuses, necessitating the removal of the tubes later. I very often see a doctor who has treated gonorrhoea to any extent, when it involved any mucous membrane, has come to realize the seriousness and far-reaching effect of this infection. I believe it is an established principle that practically the only hope we have of curing gonorrhoea is by early free drainage, for instance, gonorrhoea in the female is treated far better by packing the vagina with dry gauze once a day and removing it, if in by any amount of strong applications and douches. In rare instances it is probably true that gonorrhoeal tubes which have been tilted with pus and in which both ends have been sealed up, have reopened so that conception could take place. These instances are exceedingly rare. In some cases a single tube will become infected with gonorrhoea and the other will remain clear. These cases are relatively rare. In some cases a tube which has become sealed at both ends will become clear of pus and will have its cavity open in the middle but there will be permanent closure of the unilaterated end. Several years ago I reported a method by which several of such tubes had been opened and the mucous membrane everted with the hope of making conception possible but as far as I could learn conception never took place. However there are undoubted cases in which conception has taken place after gonorrhoeal infection, but where there is one such case there are hundreds of cases which have been allowed to run on to a chronic condition in which the ovaries were infected and destroyed and the uterus permanently involved, tubo-ovarian and vesical sinuses formed and the patients subjected thereby to years of unnecessary invalidism and danger.

There is a well-established rule among gynecologists never to tamper with an acute gonorrhoeal salpingitis or pus tubes, but in the face of this my practice has been to the contrary for



Fig. 1. Intestines are held back with a gauze pack and retractors while gauze wicks are being placed side by side across the pelvis.



Fig. 2. Gutta serena sheets of four thicknesses placed carefully above the gauze to prevent contact of gauze with intestines.

more than fourteen years. I have during this time not turned aside or postponed a single case of gonorrhoeal pus tubes of an acute violent infection because of its acuteness, and in more than two hundred pus-tube cases treated in this way approximately fifty have been operated on in a very acute stage, during the past eight years without mortality. As much against well known statistics as it may seem I have no more fear, as far as life is concerned, of opening and quarantining the pelvic organs in acute gonorrhoeal conditions than of opening and removing an interval appendix or quiescent pus tube, provided the quarantine is extensive enough and is properly placed and discreetly removed. On the other hand the use of a drainage tube or small drain of any kind does not do the same work and is followed by a large mortality in such cases.

As has been previously stated a splitting of the gonorrhoeal pus tube which has been sealed at both ends and has been treated by drainage as we treat other forms of infection, contrary to the results obtained in pus infections, usually leaves a discharging pus sinus leading to the tube, later requiring operation for its removal. The same is true in a certain number of cases in which gonorrhoeal tubes have been tied off instead of excised. In other cases an abscess will form later at the cornu of the uterus. In three cases to which I have been called the acute stage of known gonorrhoeal infection was so early that the ends of the tubes had not sealed up. The pus could be seen on the fimbriated extremity and could be squeezed from the lumen of the tube. All three cases were

in very young women and it was desirable not to unsettle them, so in these cases we used the quarantine pack without removing the tubes or any other organ. Immediately the inflammatory process subsided, the fever receded, and all three cases have apparently remained permanently well as a result of the pack and free drainage. Two of the three were operated upon more than two years ago. In other cases where we have removed one tube for gonorrhoeal infection and found the other infected but not closed, we have used the quarantine pack in the same way, and we have not been called upon to treat or reoperate upon any of these cases. It is true we have no report of such a case in which pregnancy has taken place afterward, but I feel hopeful some of them may later become pregnant. I am very hopeful that this timely drainage prevents closure of the tubes and helps to cure the gonorrhoea.

In the majority of cases, however, my practice being that of general surgeon and doing but little office treatment and no family visiting, the cases have usually been brought to me in a very active stage with a temperature running from 102° to 103° , with a rapid pulse and usually a peritonitis with distention of the abdomen. We have without exception opened such cases, and if the tubes are permanently sealed and have enclosed pus cavities within the tube, we remove the tube by excision at the cornu and place the quarantine pack. This operation in these extreme cases, of course, removes the least chance of pregnancy, but I believe that in cases advanced to this stage

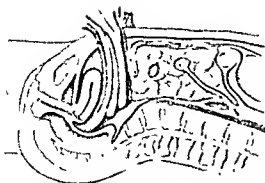


Fig. 3. Sectional view of the quarantine pack with application of gutta percha above and below the gauze. (The gutta percha between the uterus and gauze is by no means essential and is not desirable except where the primary object of the pack is to cure adhesions.)

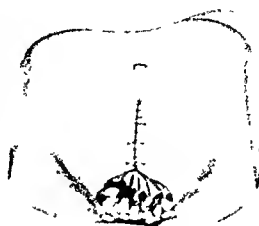


Fig. 4. Incision closed with pack protruding through lower end.

the chance is only one in many hundred that they will ever become pregnant anyway, and by doing the operation at this stage the patient's suffering is cut off at once, the ovaries are saved in good condition, the possibility of serious adhesions with perforation into the bowel is completely removed, and the patient is cured and the likelihood of permanent incurable discharge from the uterus is very much lessened.

TECHNIQUE

The quarantine pack is placed as follows:

On opening the abdomen the fluid and spilled pus is sponged out with dry gauze. The intestines are packed entirely out of the pelvis. The entire pelvis is exposed to direct view by the use of metallic retractors. A large incision is used so that the work can all be seen. If the tubes are firmly sealed they are removed by excision down to the uterine mucosa with any infected portion of the ovary, leaving the healthy portion to be healed as a result of the drainage. The retractors are held in place and gauze wicks the size of a finger (not folded like the folds of a fan) are laid straight side by side entirely across the abdomen putting sometimes twenty or thirty of these wicks reaching to the bottom of the pelvis and gradually extending up the side of the pelvis making a solid wall of gauze. After these wicks have been placed can fully a sheet of gutta percha tissue of four or six layers is placed above the gauze, care being taken that the tissue goes entirely across the lower part of the cavity, absolutely shutting off all possibility of contact of the intestines with the gauze drainage. If the tubes

are not sealed the quarantine is placed without removing them. The open ends of the tubes are left in contact with the gauze. The wicks and the rubber tissue in certain cases are then turned toward the patient's face, exposing the uterus and bladder, and another folded sheet of six or eight layers of gutta percha tissue is carefully inserted between the gauze and the fundus of the uterus, this practically surrounding the gauze and making a completely protected pad. This second gutta percha sheet should not prevent the open tubes from coming in contact with the gauze. In just one day less than a week or six full days after the pack is placed, the wicks are withdrawn leaving the rubber tissue. On the fourteenth day the rubber tissue is removed, and according to the case we either insert a small rubber tube which is tapered at the point, or leave drainage out entirely. It usually takes such wounds about five weeks to heal. For four weeks we keep the patient in bed preferably on the back most of the time.

During the past three years we have had practically no hernia following such operations.

CONCLUSIONS

1. Free drainage is the most important thing in the treatment of gonorrhea.

2. It is quite possible that a much larger percentage of tubes infected with gonorrhea may be saved and restored to normal function if seen early and treated surgically with a large protected quarantine pack, which at once gives free drainage and prevents the peritoneal surfaces from surrounding and sealing up the tubes during the first active inflammation, than can be done by the so called but misnamed conservative treatment

3. The quarantine pack used after removal of gonorrhoeal pus tubes makes the operation just as safe in the acute stage as during the interval, and saves the patients much suffering and many complications such as destruction of the ovaries, connecting the abscess with the rectum or bladder, and the formation of troublesome adhesions, as well as minimizing the chances of a chronic incurable discharge from the uterus

IMMEDIATE PERINEORRHAPHY¹

By ALFRED BAKER SPALDING M.D., SAN FRANCISCO
From the Woman's Clinic, Stanford University Medical School

IN practically every confinement at term, the pelvic floor of the primipara and of those multipara who have been successfully repaired following their previous confinements is damaged to some extent. The only patients who escape this damage are the ones who give birth to babies with very compressible heads or who possess an excess of elastic tissue in the fibrous sheaths of the pelvic floor. It is the duty of the obstetrician to attempt to limit this damage if he can, but the delusion held by many that it is possible to prevent pelvic floor laceration has added more misery to the patient than credit to the accoucheur.

Unless the condition has been repaired either immediately after labor or later or unless the tissues have become atrophic, it is a common experience in clinic work to find on examination multipara with more or less relaxation of the pelvic floor. Moreover many patients who have been repaired present themselves with various degrees of pelvic floor relaxations.

Baker Brown half a century ago, taught the profession to sew the labia together in cases of pelvic outlet relaxation and undoubtedly thousands of women were so ridiculously maltreated. A little later Thomas Emmet contributed to the ill health of women by teaching the profession the wonderfully clever, very technical undoubtedly efficient secondary perineorrhaphy that bears his name and even such distinguished obstetricians as Hegar and Singer aided and abetted Emmet in this unintentional error by directing attention to the cure rather than to the prevention of rectocele. Lawson Tait that genius to whom the profession can never pay proper tribute completed the conspiracy against healthy motherhood by

giving to the profession his classical flap splitting perineorrhaphy. He wrote, in 1870 "The day has gone when the treatment of pelvic and abdominal diseases so prevalent among women and so rare among men is regarded as the mere appendix of the work of the accoucheur," and in the same book said, "Laceration of the perineum to some extent is the almost inevitable result of the first labor but unless painful fissure or a tender cicatrix be left from imperfect recovery, it requires no treatment." Finally he said, "there

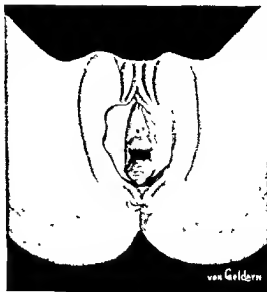


Fig. 1. Laceration of the pelvic floor involving both sides of the vagina and separating the levator ani muscles.

¹ Read before the Nevada State Medical Association, June 17, 1915.

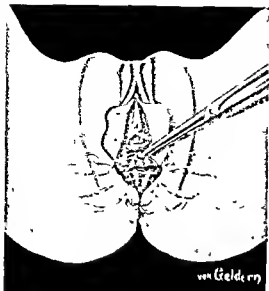


Fig. 2 Top stitches are of chromic catgut. One continuous suture to close each sulcus laceration. Lower stitches are of silk worm gut. Deep part of figure-of-eight through separated levator ani muscles. Superficial part of suture through superficial muscles, fascia, and skin.

are only two conditions which require surgical repair — rectovaginocele and vesicovaginocele.”

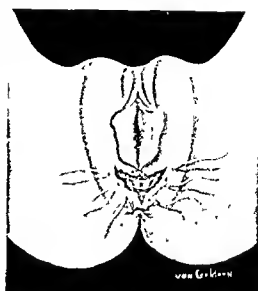


Fig. 3 The ends of the chromic gut sutures are tied together repairing the lacerated vagina.

The sequelæ to pelvic floor relaxation such as constipation, bladder irritability, backache, cervical hypertrophy, retroversion, subinvolution, prolapse, and neurasthenia are too well



Fig. 4 The figure-of-eight sutures are tied, bringing together the levator ani muscles and the superficial structures of the pelvic floor.

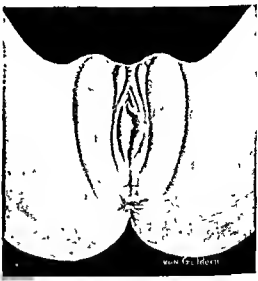


Fig. 5 Ten days post partum. The vulva is closed. The vaginal walls lie against one another, and the levator ani muscles can be palpated in normal position.

known to need discussion. The cure of these conditions occupies the attention of a large number of surgeons. There are always in the hospital many patients recovering from operations performed for the relief of these symptoms.

The time to cure prolapse is not when the uterus has prolapsed but when the woman begins her first pregnancy. Many important procedures should be considered weeks before labor starts and prophylaxis carried on, not only during the time of actual labor, but also during the period of involution which follows labor. When labor ends it is wise to agree with Tait and remember that "laceration of the perineum is the almost inevitable result of the first labor."

Proper inspection will usually result in giving more than sufficient evidence of the damage present. As to when the repair should take place, it makes little difference whether the operation is performed at once or a few days later provided operation is done before cicatrization has occurred. Complete anæsthesia immediately post-partum is best although the operation can be performed on some patients without anæsthesia. Partial anæsthesia given by an incompetent is distinctly bad. At least one good assistant is an essential to good work. The same instruments are needed as are used in the denuding operation and far more careful asepsis must be carried out. For thirteen years I have tried a number of different operative procedures to restore the damaged pelvic floor immediately after labor and have met with varying degrees of success until gradually I have perfected a comparatively simple and very efficient perineorrhaphy, the performance of which has become routine with me and with my clinical assistants.

The first step in this operation, after packing the vagina, is to locate the levator ani muscles. It frequently happens that these muscles have retracted a distance of three to four inches and unless care is taken the deep transversus perinei muscles will be sutured by mistake. The muscles are brought together with three or four silkworm-gut sutures. The second step consists in repairing separately each laceration in the vaginal sulci, which at times extend to the cervix, with a continuous light chromic gut suture, tying these two sutures finally so as to restore the base of the vulval canal. It frequently is seen, after tying these sutures, that the perineal laceration lies obliquely or almost transversely to the median raphe. The third step of the operation consists in crossing the silkworm gut sutures through the opposite superficial muscles and fascia so as to approximate the skin laceration and to tie these sutures not too tightly.

The accompanying descriptive plates explain the steps of this operation, the principles of which have been taken from accepted surgical practice.

Since performing this operation first in 1907, several papers have appeared in the literature describing operations similar to this principle although differing in technique, so no claim is made for originality. The reason for presenting the subject of immediate perineorrhaphy is not for such purpose but to call attention to the fact that the treatment of procedentia is not so difficult if prophylaxis is begun with the first confinement, which nearly always is associated with pelvic floor laceration, and if the separated levator ani muscles are repaired by an immediate perineorrhaphy.

RETRODISPLACEMENTS OF THE UTERUS¹

By J. CRAIG NEEL, M.D., SAN FRANCISCO

THE operative treatment of retrodisplacements of the uterus has been the subject of much study in every gynecological clinic for many years. The fertility of the surgical imagination is well illustrated by the publication of over fifty different operations for their correction. While many of these operations have yielded excellent results, especially when performed according to the original technique, insufficient attention has been given the individual features

of the different cases and failures have resulted from the effort to adapt one procedure to all conditions.

A diversity of opinion has existed as to what really constitutes the normal support of the uterus. The mechanism is a complex one and there are many forces working in conjunction to pose the uterus and to maintain adjustable relations without interference in performance of the various functions of the surrounding struc-

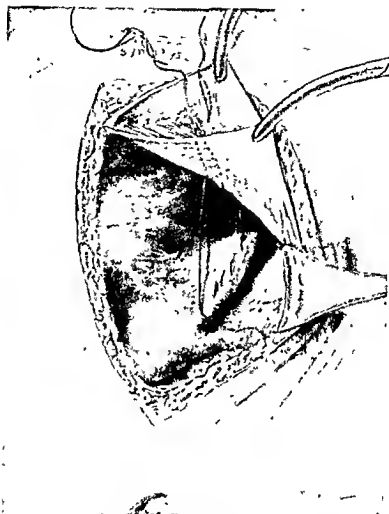


Fig 1. Shows one silk suture introduced through the undersurface of the rectus fascia, brought through the abdominal wall and carried along the parietal peritoneum to the internal inguinal ring and then taking up the anterior wall of the broad ligament and piercing the round ligament. It is then brought directly out through the abdominal wall.

tures. The supporting tissues may be divided into intrapelvic and perineal structures. Under the first division are the broad, round utero vesical, and uterosacral ligaments. The effect of the broad ligaments is readily demonstrated in cases requiring their severance from the uterus, when the fundus drops backward and finally becomes completely prolapsed on the rectum unless some additional support is utilized. The round ligaments play an insignificant part as a constant

support of the uterus while their real function is shown by the marked hypertrophy during pregnancy. When the abdomen is opened with the uterus in normal position, the round ligaments are never found on tension and in many cases leave the abdomen at a point posterior to the axis of the fundus of the uterus. Nevertheless the round ligaments are the points of attack in practically all operations for retrodisplacements while the more important structures have re-

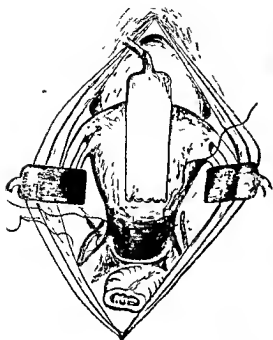


Fig 2 Shows the course of the sutures taken in the uterosacral ligaments. The ureter is indicated on either side, just lateral to the ligament.

ceived very little attention. The utero-vesical attachment permits of wide excursions and in itself probably contributes very little actual support. This brings us to a consideration of the uterosacral ligaments.

Backward displacements of the uterus are divided into two main divisions: (a) retroflexion, in which the normal position of the cervix is maintained while the fundus is bent backward into the cul de sac of Douglas; (b) retroposition, in which the normal relation of the fundus and cervix persists while there is a loss of tone in the supporting structures allowing the entire uterus to be displaced to the pelvic floor. The cervix is normally more rigidly held in the pelvis than the fundus and its anteroposterior position depends almost entirely upon the tonicity of the uterosacral ligaments. In operations so far described, but little attention has been given to the position of the cervix and its restoration to a normal position. In true retrodisplacements, as we have recently demonstrated in a number of cases, a shortening of the uterosacral ligaments not only brings the cervix into its normal position but also suspends the fundus in an excellent manner.



Fig 3 Shows sutures tied and the operation completed. Attention is especially called to the pocket made by shortening the uterosacral ligaments for the support of the tube and ovary.

Uncomplicated retrodisplacements rarely cause symptoms. Hence the effect upon the function of the surrounding structures is the important factor to be overcome in all operative procedures. Therefore the ideal operation cannot be one that merely swings the fundus into position without any regard to the surrounding structures, and unless the normal relations of the pelvic viscera are restored many failures will continue to be recorded.

The restoration of torn perineal structures acts chiefly in the support of the cervix and thus prevents the prolapse of the pelvic viscera.

The following operation suggested by Dr. Kelly and modified by me has been performed in something over one hundred cases and the results have been most satisfactory.

Through a midline incision the pelvic viscera are exposed in the usual manner and the fundus brought forward to its normal position. The fascia of the rectus muscle is then dissected free just above the symphysis pubes to allow the permanent silk suture to be anchored to the under surface about four centimeters from the midline.

incision. This suture is then carried through the underlying rectus muscle and peritoneum immediately above the vesical reflection on the abdominal wall, the parietal peritoneum is next taken up at about one centimeter intervals down to the internal inguinal ring, the suture is then carried along the course of the round ligament to a point within one or two centimeters of the uterine cornu where the ligament is pierced and the suture is brought out through the abdominal wall near the point where it entered (Fig 1). The same procedure is followed on the opposite side. Both sutures are then drawn tightly and tied, the knots being buried under the rectus fascia. The results obtained by the introduction of these sutures are: (a) The broad and round ligaments are utilized and given a broad attachment to the abdominal wall. (b) The lateral openings are closed by the purse-string action of the suture and thus prevent the incarceration of the bowel. (c) The fundus is loosely poised in the pelvis with the slightest possible mutilation.

In order to bring the cervix into its proper position a running purse-string suture of silk is taken in the cervix where it is joined by the uterosacral ligament on either side and carried along the course of the ligament to the pelvic brim (Fig 2). In placing these sutures the orifice which usually lies outside the ligament must be avoided. When these sutures are tied, the cervix is drawn high in the vaginal vault and a shelf is made on either side for the support of the tube and ovary (Fig 3).

The excellent results so far obtained from this operation lead us to believe it to be the most nearly ideal operation for retrodisplacement so far described. Its advantages are:

1. There is no mutilation of pelvic structures.
2. It leaves no injured surface to favor adhesions.
3. The normal supports of the uterus are utilized in such a manner as not to interfere with their evolution and involution and therefore it offers no hindrance to future gestation.

DUODENAL FEEDING¹

By CLEMENT R. JONES, M.D., PITTSBURGH

Professor of General Pathology, Maternal Medicine and Therapeutics, Dental Department, University of Pittsburgh, Consulting Gastro-Enterologist, Mercy Hospital, Consulting Physician, Doctors of the Stomach, Presbyterian Hospital.

ORIGIN

THE duodenal tube as used by Dr. Finhorn has been of exceptional service in selected cases from the time when it was first called to the attention of this society. From the first it impressed me as the ideal method of obtaining rest for the stomach, and at the same time supplying the body with nutritious foods at a point in the intestinal tract where it can be digested. Long before its introduction, I had given up the idea of trying to supply nourishment to the body through the colon, with the exception of water in normal saline solution per rectum.

Certain points in the modification of the treatment, suggested by Dr. Morgan have served to place the treatment on a very practical basis: (1) the longer tube which allows the food to enter the intestines at a point where it can exert no direct pressure on a duodenal ulcer; (2) the discontinuation of the use of sugar of milk in some cases; (3) the drop-by-drop method, by which it is possible to keep up a continuous flow of the nutrient fluid. In addition various slight changes in the technique must be made from time to time by those prescribing this treatment.

USES

The early cases in which it was of service were gastric and duodenal ulcer in which the methods formerly in use had not been satisfactory. It was also found satisfactory in recurring cases where it was thought advisable to vary the treatment from former rest cure methods, and in cases of long standing and of the severer type. In one of the first cases which I treated by this method, there occurred a perforation followed by fatal peritonitis. This was the only case of the kind which had occurred in a series of about two hundred cases in my service at Mercy and other hospitals and it would have been more discouraging to me had it not been followed by a second case of perforation in a patient for whom I considered duodenal feeding, but decided to use another method. This second case was one in which the pain following perforation was very acute and was promptly reported to me. The patient was operated upon within three hours and made an uneventful recovery.

These were both cases of duodenal ulcer. In the first series of cases a much shorter tube was used than is now employed. Since using a tube

of a length which will allow about fifteen inches of tube for the duodenum, the comfort of the patient has been increased, the possible danger of perforation from pressure has been removed, and the results have been more generally satisfactory.

In a number of cases of ulcer I have used along with the tube, feeding a daily dose of scarlet red in capsule given by mouth along the side of the tube with apparently good results. The nature of the treatment, however, is such that a considerable number of cases would be necessary to show that any definite advantage was obtainable by its use. The results reported from the use of scarlet red by Doctors Friedenwald and Leitz I believe justify its trial in selected cases, especially of the recurrent type or those which have failed to respond to other forms of treatment.

The use of this method of feeding in cases other than ulcer, has broadened the field of application. I refer to cases of ptosis, atony, and dilatation of the stomach. In this use of the treatment I have in some instances been successful in relieving these conditions when other methods have failed. One of the most interesting of these cases I here report. These patients are either normally very thin or are well below their normal weight and tone and present a syndrome sometimes difficult to differentiate from ulcer.

Since the earliest study of atonic gastric diseases many forms of treatment have aimed at giving rest to the stomach, but until the duodenal tube was suggested nothing more than partial rest was attainable. By duodenal feeding we are able to keep up the nourishment to an amount sufficient to maintain the body weight or increase it and at the same time rest the organ, giving time for recuperation of the atonic or ptosed stomach. In some cases the same food introduced through the tube into the duodenum could not be taken care of when taken into the stomach, in fact it was so changed by long retention in the stomach that it had become unfit for intestinal digestion. In the case of Miss M. there seemed to be at all times a residual content in the stomach which prevented the food passing into the duodenum without contamination.

After feeding is begun through the tube, there is perfect comfort on the same liquid foods which cause distress both gastric and intestinal when taken by mouth. In such cases we have the problem before us of so increasing the efficiency of digestion by rest and forced feeding as to increase the weight and tone to a point where the fat and tonicity approach normal. When the patient has regained his normal weight and has

maintained that weight for a sufficient length of time, say one year, it may be safe to return to a not too confining vocation.

The period of the treatment of atony, dilatation, and ptosis during which duodenal feeding is being used is only the beginning of the treatment when time is considered, but as a good start it is half the race and a good foundation necessary to a permanent structure. So this rest of body and stomach which also admits of forced feeding gives momentum to the launching of these therapeutic measures and permanence to the results. If the dietary and hygienic regimen which should continue for varying long periods after the duodenal feeding has been discontinued is observed by the patient, an increased number of these patients should regain their normal health. Improvement in the general tone and catabolic functions of the body being the object of medical management of all cases of this kind, such temporary means as will bring about a rapid reconstruction cannot, I believe, fail to become more and more popular as a part of the treatment of atony, dilatation, and ptosis.

DIFFICULTIES

In cases of extreme ptosis and hypomobility it is sometimes a number of days before the tube will pass through the pylorus. However, persistence will usually be rewarded by success. If it takes longer than twelve hours for the tube to pass the pylorus, I order the patient fed as usual as though the tube had not been introduced. In a recent case the ptosis was so extreme that the tube failed to pass after more than two weeks.

In one case I had great difficulty in withdrawing the tube which was introduced in a very normal way, but when my assistant attempted to remove it three weeks later, it was firmly held by the œsophagus, about 25 cm. from the teeth, where it remained until the following day at which time I removed it by very strong traction while the patient stood behind a fluoroscopic screen where we could observe the progress upward of the metal ball. The ball was so firmly held that I was not willing to make sufficient traction on the tube to remove it prior to using the fluoroscope, by means of which I could watch the effect on the ball, and see that it was gradually moving upward. The contraction about the ball extended for several inches along the œsophagus, and was, I believe, spasmodic as the patient was of a very nervous type. It occurred to me afterward that an anti-spasmodic or atropin might have been used in this case with good results.

... used in my work is ... the tube with much ... in introducing the ... swallows the ... and we gradually ... the metal olive is car- ... on his right ... position until ... demonstrate the ... duodenum ... seven days ... withdrawal of ... by means of ... purpose, we ... of codine ... the tube is in- ... sensi- ... the ... used for a ... of faulty ... I dis- ... in one ... with it ... and the ...

... of ... heated ... We use ... in such ... intra- ... from ... the ... per ... each day ... to ... every ... end- ... to ... to ... cent ... cent ... per ... I ... of ... changes in the techn- ... to time by those pres-

is the straining through three or four thicknesses of fine linen after the final heating so as to remove any clot of milk or eggs which might obstruct the tube

In a patient recently treated, milk did not agree and was found in the faces in large curds, there was constipation, distention with gas and discomfort, and the patient did not sleep well. Two ounces of milk were modified by diluting one half with water and adding citrate of soda one gram to the ounce, also the white of an egg. After feeding successfully for several days the milk was increased to six ounces, the water to six ounces, with one whole egg every two hours. Constipation cleared up on a total dosage of 63 grains daily of citrate of soda.

The service of a carefully trained nurse for this work is necessary. When one has a nurse who has had experience in a number of these cases, the work will not so frequently demand extra attention on the part of the physician.

The capacity of the duodenum seems to vary almost as much as that of the stomach. One patient will complain of slight discomfort if the feeding proceeds faster than usual, another will experience no discomfort with comparatively rapid feeding. However, as the patients whose duodenums have small capacity become more accustomed to the feeding they are able to take the full ordinary feeding of twelve ounces without distress of any kind.

In the treatment of ulcer I have seldom fed more than 84 ounces of milk and six eggs per day, and only in those cases under weight in which an increase in weight is desirable have I carried the feeding to the extent above mentioned.

CASE 1. In May 1911 Miss M, a nurse, complained of pain after meals, loss of weight, eructation of gas. Stomach contents showed no free hydrochloric acid, total acidity 20, no blood in feces or stomach contents. Diet in bed was advised and liquid diet. The patient improved and as she was in training in the hospital, after treatment was such as could be given and work continued. The patient was fairly comfortable until April 1, 1914, when she again consulted me giving a history of the return of gastric distress, pain soon after meals and continuing for some hours. Weight 116½ pounds, former weight 155, is 20 years old. Stomach contents shows no free hydrochloric acid, total acidity 20, a trace of bile. Blood hemoglobin 90, red cells 4,250,000, leucocytes 8,000. Laves occult blood negative.

Röntgen examination shows stomach apparently devoid of tone, duodenal feeding advised and tube introduced. The tube entered the duodenum on the seventh day. Feeding was begun with 2 ounces every two hours increased 2 ounces per hour per day up to 12 ounces. On the sixth day added one egg a. d. then one egg every four hours. No symptoms were relieved. Stomach The patient set home at end of 5

continuance of food rapidly, and was to pour in.

On May 25, 1914, the patient returned with the same symptoms. The pain is more severe and she thinks she must have something more serious than we are able to find by X ray or other diagnostic methods. She suggests an exploration, as a neighbor with similar pain had been operated on and an ulcer found.

Condition before operation. General condition fair. Has some pain over cæcum. Pain not marked, but is present more or less all the time. Red blood cells, 5,800, 000; white blood cells, 6,000. Operated on June 3, 1914.

Macroscopic. Appendix about five inches long, hard, undergoing obliteration. No adhesions. Meso appendix perfectly free. Abdominal contents examined. Stomach and duodenum normal to touch. Stomach slightly ptosed.

Transverse colon found in pelvis, could be lifted out at least ten inches from incision. Cæcum slightly mobile. No Lane's kink or Jackson's membrane. Gall bladder and pancreas normal. No pathological condition found save ptosis. Large bowel contained much hardened fecal matter. Uterine organs normal. Both kidneys displaced.

Duodenal feeding was begun again on June 20, and continued six weeks. Weight on July 1, 1914, 110 pounds, on July 29, 135½ pounds—a gain of 25 pounds in four weeks. The smallest amount of food given in any one day during the last four weeks was 96 ounces milk and six eggs, largest amount taken in 24 hours, 128 ounces of milk, 10 per cent butter fat and 14 eggs. During this period no symptoms of gastric or intestinal character were in evidence, the abdomen was soft, no laxative was necessary and there was no diarrhoea. The patient frequently remarked if she could only hope to be as comfortable after the tube was removed as during the treatment she would be well satisfied.

History since leaving hospital. Had some gastric symptoms of a mild character during the first few weeks after leaving hospital which gradually disappeared. In a letter dated Columbus, Ohio April 25, 1915 patient stated "I am in excellent condition physically. My weight has increased from 110 to 153 pounds. My stomach has not caused me even the slightest discomfort during the last four or five months."

Case 2. A hotel clerk entered the hospital November 1, 1914, having had an attack of severe hæmatemesis. He gave the following history. In 1909 had a rest cure of the von Leube type for gastric ulcer. At that time he gave a history of a previous partial rest treatment. Treatment by von Leube method with subsequent restricted solid diet, gave relief of all symptoms until August, 1910, when he had an acute attack of appendicitis. He was advised by a surgeon that his symptoms in previous history were all due to appendicitis, and that restricted diet was unnecessary. After a short period symptoms of ulcer returned and continued with more or less severity until his profuse hæmatemesis occurred on the day of his admission to hospital November 1, 1914. He gave an account of having been papering a bath room in his apartments the evening before and his wife noticed his pale condition at breakfast. He felt somewhat nauseated at times during the day and at 6 p. m., vomited a large quantity of dark clotted blood. He was sent to Mercy Hospital and his symptoms at 7 p. m. were extreme pallor, slight nausea, pulse 100, respiration 4, temperature 99°. Ordered ice to epigastrium, morphine ½ gr hypodermically, adrenalin 1:1000 in thin gelatine ½ ounce every third hour. November 2, 1914. Normal salt solution 6 ounces per rectum every fourth hour. Ice by mouth in small quantities. November 5, 1914. Albumin water every third hour. November 7. Milk 2 ounces every third hour. November 8. Duodenal tube introduced. Feeding continued until December 12, 1914.

Examination of feces on November 14, 1914 was negative for occult blood (benzidin test), also November 16, 18, 20, 23, 27 and December 2.

December 19, 1914 discharged from hospital. January, 1915, condition good.

Case 3. Married woman, age 28. History of ulcer, nine years ago, no symptoms during that time.

The patient was taken ill November 25, 1914. I was called in consultation December 11, by Dr. Everhart who asked me to take charge of patient. She was removed to Mercy Hospital, and for two weeks she has been on a liquid diet, has rested in bed and his had hot poultices on the epigastrium. There has been no improvement in the pain, which is severe. It comes on when the stomach is empty, she vomits small quantities of blood. These symptoms continued for two weeks. Blood was present in stools. Blood count: leucocytes 12,000, red cells 3,050,000, hæmoglobin 76, December 30, 1914. January 5, 1915, blood count: leucocytes 6,800, blood present in stools, December 22, 23, 31. January 4, 6, 12, 1915, negative. Blood present in emesis December 28, 1914. Urine normal.

The patient was put on duodenal feeding, the tube was in place in twelve hours. Pain was only partially relieved, but became gradually less and ceased entirely at the end of one week. Feeding was continued for four weeks. The patient returned to solid diet gradually, and she had no pain or distress of any kind up to leaving the hospital.

Condition February, 1915. No symptoms on restricted solid diet.

March 30, 1915, condition well.

Case 4. March 19, 1914, Mrs. L., age 49, consulted me complaining of stomach trouble of fourteen years' standing. She has been treated in Carlsbad and Europe, has noticed that for a long time, stomach retains food until after the time of the next meal and frequently puts her finger down her throat to induce vomiting which gives her relief, bowels constipated and complains of acidity, analysis of stomach contents shows total acidity of 36, free hydrochloric acid, 20, very little mucus, very faint positive benzidin reaction, physical examination no points of tenderness in the region of the stomach, gall bladder or appendix. Röntgen examination shows stomach atonic and ptosed, somewhat dilated. Entered hospital April 15, 1914, was given treatment by duodenal feeding for four weeks, examination of stomach contents June 15, 1914 showed total acidity 52, free hydrochloric 40, Röntgen examination by fluoroscope showed greatly improved gastric motility. Stomach in practically same position as before treatment. Patient can now take three meals of moderate quantity without distress. October 16, 1914, patient has continued well with quantity of food considerably increased with the exception of occasional slight distress from an exceptionally full dinner.

May 1, 1915, on inquiry as to present condition she reports that she is in better health than she has been for some years.

Weight normal at 140.

An interesting observation was made in a number of cases of ptosis treated by this method. We found on roentgenological examination when patients were symptomatically well that the stomach remained in practically the same position as when examined prior to treatment. I believe that the position of the stomach in these cases is relatively unimportant, the symptoms probably being due to lack of normal tone.

DISCUSSION

Dr Julius Friedenwald, Baltimore I have used the tube a great deal for the feeding of patients with ulcer not relieved by the usual method of feeding, and in cases of persistent vomiting. It is especially useful in cases of persistent vomiting not relieved by other methods. I am quite convinced that I have saved the lives of some patients by the use of the tube. One patient especially who had nearly succumbed to the vomiting began to pick up after the use of the tube, and I am sure that the treatment saved her life.

Dr Franklin W. White, Boston I should like to say just a word about the subject. It seems to me that this method is too much neglected. When I tried it last year in the Boston City Hospital, I found that that was the first time that it had ever been used there. It is valuable in selected cases, but not as a routine procedure. In a limited group, like these cases of atony or malnutrition, or persistent vomiting, I think that the results are quite brilliant at times. I have been impressed with the results in my own practice during the past year, even when the tube had to be sent out to the country with full directions to be used by a local doctor.

In severe cases of ulcer with vomiting, malnutrition, dry tissues and perhaps hemorrhage, I have found this method valuable in preparing the patient for the operation.

Dr Billy Meyer, New York City It would not be fair to Dr Einhorn not to corroborate the statements of Dr White on the basis of my personal experience. I am using the tube more and more in my work, and find it a valuable therapeutic adjunct. My experience with it is limited to ulcer cases, in which I find it most valuable.

Dr Seymour Basch, New York City I would suggest that Dr Einhorn be asked to say the last word.

Dr Max Einhorn, New York City Dr Jones says that in one of his early cases he feared that the perforation might have been due to the use of the tube. In my large

experience, and I have had a very extensive experience with this method, I have never had any perforation from its use. The tube is about one meter long, and I let it go in about eight centimeters from the teeth. I think that is far enough, but we can let it go in as far as ninety-two centimeters. In one case, I had to pull it out a little, because the patient could not stand having it deep in the small intestine.

Dr Bloodgood Will you please repeat the length?

Dr Einhorn The whole tube is usually one meter long, and we let it go in to about eighty, and sometimes to ninety centimeters. Usually, however, it is enough if it goes in to between seventy and eighty centimeters, because the pylorus is only fifty-six centimeters from the teeth. When the tube is allowed to go in eighty centimeters, it is twenty-four centimeters beyond the pylorus, which is quite a long distance.

Now there is one more point that I should like to speak of, and that is concerning the remarks about atony, dilatation, and ptosis made by Dr Jones. He said that he had found good results from the treatment in these cases, but no change in the conformation of the stomach. I do not doubt that such cases may occur, but I have notes of cases in which I did find a change. In about half of the patients that I examine merely on account of this extreme stomachically dilated stomach, I find that after two weeks without food in the stomach, there is a change in the shape of that organ, so that it extends only to the navel, instead of hanging lower. I do not think that this happens in each case, but it may occur.

Another statement to which I wish to refer is one made by Dr Aaron, who said that he never finds a change in the anatomy of the condition. I do not substantiate that. We can see these cases and institute measures of building up the patient, and a year later find the ptosis gone. There is no ptosis or movable kidney after the building up of the system, and I am sure that there are clinicians here who will substantiate that statement from their own experience.

THE TECHNIQUE OF PYELOGRAPHY

BY STANLEY R. WOODRUFF, M.D., BAYONNE, NEW JERSEY

TO bring pyelography down to a safe and sane basis we have endeavored to absorb the ideas of some of the pioneers in this work and use them in connection with our own experience. We have found the taking of skagrams an absolutely safe procedure in every way if done with care and gentleness. These are the two watchwords of good pyelography—care and gentleness. With these always in mind there will be no deaths in this work.

Our technique as used at the Bayonne Hospital and Christ Hospital, Jersey City, is as follows:

The patient, with bowels prepared, is placed in the usual position for cystoscopy, on a table directly under the X-ray tube. This is the most important point in the whole procedure and to disregard this point causes great discomfort to the patient and possibly his death. The best arrangement is to have the cystoscopic room next to the X-ray room so that wires and a window may be cut through and a tube used at any time in the cystoscopic room. This arrangement makes it possible for the X-ray operator to go on doing his own work, and when the cystoscopist is ready with his patient the X-ray man can readily snap him. This allows each man to keep out of the way of the other, and facilitates matters greatly in a busy clinic. Where this arrangement is not feasible the X-ray room must be used.

We use collargol mostly in our work. We purchase it already prepared by the manufacturer, which is a far better procedure than to try making solutions, and it is always ready, thoroughly dissolved and sterile.

Our object in writing this paper is to emphasize the importance of insisting that all work on the patient be done under the X-ray tube. We believe that most of the injuries and deaths reported have been due to careless injecting and subsequent rough handling of the patient. We all know that the urinary bladder distended with fluid will probably not rupture unless subjected to some sudden jar. We are sure that the kidney pelvis when full of collargol will not rupture unless under the same circumstances. Therefore, after the collargol has been injected the patient should be kept absolutely quiet until all manipulation has been done and the fluid has drained away. We insist on the patient lying

quietly on the table for a half hour after the picture has been taken to allow the kidney pelvis to empty itself. We do not leave the ureteral catheter in place unless a large amount of collargol has run in, showing a cavity, as we believe the ordinary ureteral peristalsis will empty the kidney pelvis much quicker than it will empty through the catheter. We also take care that the bladder is empty of cystoscopic fluid in order to obviate back pressure from that source.

We insist on there being no pain from the injection of the collargol. We consider our technique absolutely wrong if we have caused colic or distress. It is not necessary to distend the kidney pelvis or the cavity to be photographed at all, as the peculiar viscosity of collargol allows it to cover the inside of any cavity even when not filled by it. Eisendrath has clearly shown that overdistention and overpressure are the cause of all trouble after pyelography.

If we wish to measure the cavity to be injected we use a solution of methylene blue, running it in also by gravity and watching for its exit alongside the catheter in the ureter when the cavity is full.

As an apparatus we use the barrel of a good-size glass syringe, holding about 20 ccm. and graduated to show the amount of fluid we run in. A small rubber tube is connected with this and at the end is a small stop-cock. This apparatus can be put together by any one.

After the cystoscope is in place and the catheter inserted to the pelvis of the kidney a cystoscope holder should be used to hold the instrument in place and give the operator the use of both hands in the subsequent manipulation.

The operator sits in front of the patient in the usual position and connects the stop-cock to the ureteral catheter, which, by the way, should have a funnel-shaped extremity, the junction being wound with adhesive plaster to prevent leakage. If a funnel catheter cannot be procured a small rubber tube connector may be used. The stop-cock may now be turned and the collargol allowed to run in, the operator holding the receptacle in the left hand at such a height until he sees the top of the fluid recede. It can then be lowered to a point about a foot above the patient's body depending on his or her corpulency.

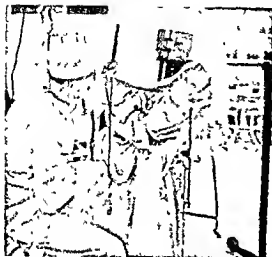


Fig. 1 Shows the proper position of the patient X-ray tube and operator for pelvis X-ray



Fig. 2 Shows the operator looking into the cystoscope to detect any collargol coming out the ureteral opening

We do not believe in using a fixed stand or point to which to attach our injecting fluid. We think this should always be under the hand and eye of the operator to instantly answer any sign of distress by lowering the receptacle or raise it a trifle if the fluid does not run.

The operator should from time to time glance into the cystoscope and see if any collargol is coming down alongside the ureteral catheter. The presence of collargol should be a signal for lowering the pressure of the injecting fluid, which can readily be done by dropping the left hand a trifle. It is also a signal for taking the skiagram. If the patient must be shifted a trifle to get the X-ray plate under the back, the swivel-joint on the cystoscope holder must be loosened so as to allow movement of the instrument and not traumatize the bladder mucosa. The better plan is to have a frame with an X-ray pervious top made to be placed on the table, as advocated by Hugh Young, before the patient is laid there. This frame should be just high enough to enable

the operator to slip an X-ray plate under the patient at any time, thereby doing away with any disturbance of the patient.

With the cystoscope held firmly in position, with one hand holding the injecting fluid and an eye on the ureteral mouth in the bladder, with the X-ray tube over the patient ready to snap the picture, we can conceive of no possible way of injuring a kidney.

This technique will do not only for collargol but for any X-ray positive substance as thorium citrate, recently advised by Burns of Baltimore.

We use this in 15 per cent solution, and have modified the authors technique by adding a small amount of methylene blue. The solution of thorium citrate is absolutely colorless, which we consider somewhat of a drawback. We like to be able to trace our injection fluid, and without color it is impossible to tell when the thorium citrate solution has filled the cavity and is being discharged down the ureter alongside the catheter.

TECHNIQUE OF NITROUS OXIDE ADMINISTRATION IN OBSTETRICS¹

By A. K. PAINE, M.D., F.A.C.S., Boston

IN view of the increasing interest in measures designed to relieve the severity of pain during labor, this communication is offered in the hope that the practicability of nitrous oxide for this purpose may become more generally known and thereby more widely used.

Recent articles by Heaney, Davis, Lynch, and others have described the use of nitrous oxide during labor, but have perhaps not emphasized the comparatively simple technique of its administration with the consequent availability of this procedure not only in the well-equipped hospital, but in the general practice of obstetrics.

The author's experience with the use of nitrous oxide in obstetrics extends over three or four years, during which time the technique of administration has undergone various changes and modifications until that about to be described seems most satisfactorily to meet the requirements. The earlier work, done in association with Dr. Austin Brant, was with one of the so-called gas-oxygen machines, using the percentages of nitrous oxide and oxygen commonly used in general surgical anesthesia. With this earlier work an attempt was made to secure a more or less continuous analgesia, but the difficulties attending the maintenance of an even analgesia, together with the mechanical difficulties experienced with the early gas machine, rendered its use not entirely satisfactory. From it, however, certain essential facts concerning the use of nitrous oxide in obstetrics were ascertained. These may be summed up briefly.

The so-called analgesic state secured by the administration of limited amounts of nitrous oxide is sufficient to materially lessen if not to entirely prevent the pain experienced during a uterine contraction.

This analgesic state may be secured so quickly as to make the inhalation of the gas unnecessary until the actual beginning of the contraction. Further the state continues for an appreciable interval after cessation of gas inhalation, making the actual administration necessary only during a portion of the uterine contraction.

These facts indicate that the amount of gas inhaled is so small and the time of its administration with each pain so short as to obviate the necessity of gas-oxygen admixture to prevent cyanosis.

With the administration of nitrous oxide during

uterine contractions, clinically it is observed frequently than an appreciable increase in the duration of the contraction results. A possible explanation of this may be found in the increased carbon dioxide content of the blood ensuing during the administration of nitrous oxide, the former being described as having a specific action in the stimulation of unstriated muscle fiber.

The use of nitrous oxide in obstetrics is essentially adapted to the period in labor between the beginning of the more severe pains and the time when obstetric ether or general anesthesia would ordinarily be begun. It is not advanced as a substitute for ether in obstetrics in any sense, but rather is to be used as a means at our disposal to relieve the suffering of labor considerably in advance of the time when the use of ether is wise or practical. When, however, labor is sufficiently advanced to permit of obstetric ether that agent is more advantageously employed than nitrous oxide, allowing a more satisfactory control of the labor than does the gas, the latter with its light and transient anesthesia not preventing excessive straining, etc. The attempt to secure complete anesthesia with nitrous oxide and the maintenance of that state, necessitates oxygen admixture with more or less complicated appliances to secure proper proportions and continuous flow, and that with a resulting anesthesia so light, so easily disturbed as to be maintained with some difficulty in obstetrical work, where changing positions, the nature of the trauma, all combine to upset that delicate balance gas-oxygen anesthesia demands, thus offering several disadvantages and no marked advantages over ether anesthesia. The substitution of ether for gas sometime in advance of the actual birth further does away with all problematical effects of the gas on the newborn, as well as the possible increased tendency to hemorrhage during gas administration.

The administration of nitrous oxide in small amounts during each uterine contraction makes the total amount of gas inhaled during several hours correspondingly small, one of the smaller tanks containing 100 gallons of nitrous oxide being sufficient for four or five hours' administration.

The apparatus necessary for obstetric administration is very simple and together with a small tank (100 gallons containing enough for an ordinary case) weighs not more than 10 pounds,

¹ Read before the Boston Chirurgical Society November 26, 1911.

adding not impractically to the obstetric outfit to be carried. One hundred gallons of nitrous oxide costs about two dollars, which is indicative that the additional expense of its use in confinements is not prohibitive.

The so called White inhaler such as is ordinarily used for nitrous-oxide anaesthesia in dental work seems the most satisfactory face piece. This inhaler has an inlet and outlet valve, the former being removed to allow rebreathing, and an opening and closing device, pressure on which allows gas to enter the face piece, with release of pressure, the gas is automatically shut off and the patient breathes air. This represents a not unimportant part of the device, for it permits the filling of the bag with gas and its retention until its use, with only escape of the nitrous oxide into the inhaler as it is definitely needed.

To the inhaler two or three feet of non-collapsible five eighths inch tubing is attached connecting at the other end with the rubber bag which, fully distended, is capable of containing about two gallons of gas, the bag in turn is connected with the gas tank by a length of small tube and the usual connection supplied with the tank. The technique of its use is as follows.

Its administration is begun as soon as the pains are of sufficient severity to warrant an attempt at their relief. Naturally the time varies with different patients and with different labors, approximately it corresponds in the majority of cases to the last half of the first stage, and the first half of the second stage, a period ordinarily productive of perhaps the greatest and most poorly borne pains and yet one not in the majority of cases advantageously managed by the use of obstetric ether. Needless to say the realization by the patient of possible relief at hand, available at any time, in many cases exerts a not unfavorable effect on the manner in which the suffering is borne.

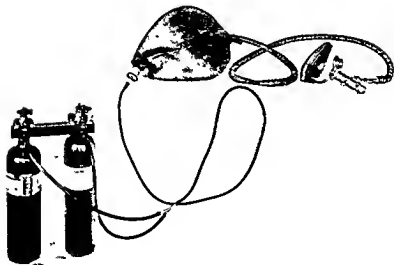
It is well to explain in advance of administration just what is expected of the patient, and of the analgesic, for the patient's co-operation is important in securing the most satisfactory results. Of what this explanation would consist will be obvious as the description of the process follows.

In an interval between pains, gas from the tank is allowed to flow into the bag until it is approximately half full. The actual amount needed in a given case will easily be determined after a few inhalations and that amount may be then let into the bag each time. It has seemed in our experience, however, that a two-gallon bag need rarely be filled, for each pain, more than half

full, and frequently a smaller amount is sufficient.

The patient is instructed to state the first consciousness of a beginning pain or that fact is elicited by abdominal palpation, at which time the face-piece is firmly applied and the gas allowed to enter, the patient breathing deeply and rapidly; ordinarily six or seven inspirations are sufficient to produce the analgesic state, and as well to exhaust the gas in the bag; should analgesia not result from this number of inspirations, or should it be apparent that the amount of gas in the bag would not permit of many more inspirations, the outlet valve is held closed with a finger and the patient rebreathes into the bag, two or three such rebreathings being ordinarily sufficient. We have considered this an essential point in technique, to rebreathe two or three times at the end of each administration, thus not only reduces materially the total amount of gas consumed, but seems also to hasten the analgesic state with a consequent lessening of the actual time the face piece is in position. In actual time elapsed about one-half minute is required to secure the fullest analgesia which about corresponds to the maximum intensity of the pain, the analgesia persists for from one half to one minute after removal of the gas, gradually lessening, corresponding somewhat to the course of the contraction. It is noted that this period of analgesia after cessation of administration depends in length somewhat on the patient's behavior, the attempt or desire of the patient to "come to" materially shortening it, and the importance of relaxation or "giving in" to the effects produced is impressed upon her.

The best evidence of the induction of the state of analgesia apparent to the administrator is the appearance of a very definite relaxation of the patient, breathing deeply and rapidly at first as instructed, with other movements indicative of the beginning pain; the analgesic state is indicated by a cessation of active muscle efforts, the breathing becomes quiet and normal, voluntary movements become less and the patient gives no particular evidence of undergoing severe abdominal pain. This analgesic state is very quickly learned and recognized by the patient herself, and, being reached, she will often remove the face-piece, conscious of no further need for the analgesic. An analgesia carried too far, or into an actual anaesthesia, manifests itself by the appearance of the deep breathing characteristic of gas anaesthesia, perhaps preceded by evidences of a stage of excitement and further indicated by a definite cyanosis. As



Nitrous oxide appliance for obstetric analgesia showing inhaler, bag (partially inflated), and tank connection

regards cyanosis during gas administration for analgesia in obstetric work, it may be said that the manner described such administration is not sufficient to produce a definite cyanosis. We have noted a change in color preceding the appearance of actual cyanosis which might be described as a precyanotic pallor, this being a rather typical paleness especially in contrast to the heightened color appearing during the latter part of the analgesia after removal of the face-piece. Actual cyanosis during the obstetric administration of nitrous oxide means to us an error in our technique, generally its continuance longer than necessary to secure analgesia, or delay in securing analgesia due to an ill fitting face piece with air admixture resulting, or to too slow breathing, or to definite resistance by the patient.

We have evolved a rule as regards this aspect of gas administration to the effect that should the inhalation of the fairly definite amount of gas prove insufficient to secure analgesia during a given pain we do not attempt to secure it by the addition of more gas or excessive rebreathing, but rather stop its inhalation and with succeeding

pains attempt to ascertain the difficulty which is generally one of those mentioned and readily corrected. A not uncommon difficulty experienced at first was the quick passage through the analgesic state to beginning complete anesthesia from the excessive use of gas when a stage of more or less excitement seemed to indicate that the patient was not getting relief from pain.

With the passing of the analgesic state, the patients not infrequently exhibit a slight degree of cerebral excitement, talking of their sensations, freedom from pain, etc., with more volubility than is ordinarily the case, though after the administration of gas at recurring intervals has gone on for some time that tendency seems to pass.

As regards the effects of long continued administration of nitrous oxide (five or six hours), in the manner described, it has been impossible clinically to demonstrate ill effects either as regards mother, child, or the course of labor. On the contrary, a definite stimulation of uterine contraction is sufficiently often observed as to make this an apparently to be expected result of the use of nitrous oxide in obstetrics.

AN IMPROVEMENT IN SCREW-HOLDING FORCEPS FOR BONE WORK

By JOHN HUNT SHEPARD, M D, CORER D'ALENT, IDAHO

THE accompanying illustration shows a forceps which overcomes certain difficulties experienced in holding the screws in plating and also in nailing fractures. The forceps is nine inches long over all. The tip

held there by little screws made flush with the blade.

In grasping a screw or nail it is held securely by these springs while at the same time the screw may be turned or a nail may be driven without



Fig 1 Forceps open showing spring

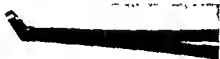


Fig 2 Forceps closed

of it is turned up at an angle of forty-five degrees. The point of superiority in this forceps over any other which the writer has used is in the springs, marked A in Fig 1. These springs are inserted on the inner side of the blades, as illustrated in the picture. They are set in grooves and

releasing the grip on the handles of the instrument. The writer has found that with this instrument it is easier to direct the course of the nail or screw than it is with an instrument which has to have the grip released in order to insert the nail or screw into the bone.

RADICAL AMPUTATION OF THE BREAST UNDER LOCAL ANÆSTHESIA

By HERBERT P. COLE, M D, F A C S, MOBILE, ALABAMA

RADICAL removal of the breast with complete axillary dissection under local anesthesia is, in so far as I am aware, a unique procedure in America. In presenting the following technique and case report, I do so giving all credit to Professor Braun of Zwickau as our procedure differed from his in but a minor essential. The readiness with which anesthesia was accomplished in our case permitting no limitation of dissection, together with absence of operative and post-operative risk, urges my calling the attention of the profession to this method which has been successfully performed in at least twelve operations for amputation of the breast by Professor Braun up to 1914.

Operation, April 17, 1915. The patient, an emaciated woman, 61 years of age, suffered with a rather severe grade of chronic interstitial nephritis. Preliminary administration of scopolamine and morphine was made one hour be-

fore, and fifteen minutes before operation. The anesthesia was produced in three stages.

1. The brachial plexus was first injected after the method of Kulenkampf, a small wheal being made over the middle of the left clavicle at its upper border. The patient in a sitting position, a needle 5 cm. in length was directed inward and downward toward the spinous process of the third dorsal vertebra to a depth of 2 cm. The patient complained of parasthesia over the distribution of median and radial nerves. There being no flow of blood from the needle 10 cc. of a 2 per cent novocaine-adrenalin solution was injected, the needle being forced slightly deeper during the last of the injection. An additional 10 cc. of a 1.5 per cent solution was distributed in the immediate surroundings. Complete sensory and motor paralysis of the arm was present in from 3 to 4 minutes.

2. After the method described by Kappis, paravertebral conduction anesthesia was obtained by infiltrating around the first to eighth dorsal nerves, using 5 cc. of a 1 per cent novocaine-adrenalin solution at points 3.5 cm. from the median line at a depth of from 4 to 5 cm. feeling the rib or transverse process. The point of the needle was then directed past the lower border of the bone from 1 to 2 cm. deeper and toward the median line at an angle



Fig 1 X marks point of brachial plexus injection. Solid line marks infiltration blocking supraclavicular branches. Dotted line marks blocking of overlapping innervation of sternum. NOTE: We have not blocked below breast as advocated by Braun.

of from 20 to 30 degrees. Five ccm of a 10 per cent solution of novocaine adrenalin solution was then injected about each nerve.

3. Finally, 90 ccm of a 0.5 per cent novocaine adrenalin solution was injected subcutaneously along the clavicle and down the inner border of the sternum blocking off the supraclavicular branches and overlapping the innervation from the opposite side of the sternum. We made no injection of the tissues below the level of the breast. In this particular we differed from the method employed by Braun. The time required for these injections was about twenty minutes and produced absolute anesthesia permitting a very extensive dissection over an hour and forty five minutes. A Jackson incision was made, both pectoral muscles removed and the axilla carefully dissected. The Jackson incision permitted closing without



Fig 2 Note points of injection for paravertebral conduction anesthesia.

grafting aillary drainage. The patient was entirely conscious throughout the operation and complained of no pain.

Post operative. The patient returned to the ward with a pulse of 78, was placed in a sitting position and then given her breakfast. There was no post-operative nausea or vomiting. There were no urinary changes, and she was on general diet without missing a meal during her hospital residence. Discharged in 10 days.

Pathological examination. Adenocarcinoma of the breast with axillary involvement.

CONCLUSION

The ease and safety with which this anesthesia may be produced, without risk of entering the carcinoma field with the needle, warrants its application in cases suffering from cardiac, pulmonary or renal complications.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

By MAJOR G SEFLIG, Sr. Louis

If one were to tabulate all the possible perfunctory tasks in the world of acts, he would probably find that the one most perfunctorily done is the average medical book review. The reasons for this are very patent and require neither discussion nor explanation. The intelligent reviewer should, of course experience no difficulty in steering clear of the slovenly formalism which is the tap-root of perfunctory reviewing. His problem, and by no means is it an easy one, is the cultivation of a judicial attitude of mind, nor will it suffice merely to be a judge—he should always temper judgment with mercy. How simple for the reviewer, with the last word always at his command and his identity usually concealed by anonymity or by initials, to arrogate to himself the right to hoist the colors for "No Quarter Given" and proceed to "slam" a book until he has repulsified it and its author. On the other hand, how difficult it is to cultivate the tendency to try to read into a volume that which the author hoped to put into it—to be generous yet discriminating in bestowing praise, guarded yet sure in picking flaws, broad yet firm in balancing the good against the bad.

These thoughts were called into being by an editorial in a recent issue of the literary supplement of *The New York Times*. The editor tells a story of an ignorant village barber, who considered himself pre-eminently fitted to be a dramatic critic, because he had endowed himself with an imaginary innate ability to see faults in dramatic productions, where others saw virtues. The editorial goes on to say, "Like our barber, every one who can pick faults in a book, or who can substitute his own theory for that of its author, imagines himself for that reason, a competent book reviewer." Then there follows a paragraph which should be hand initialed, illumined, framed under glass, and hung just above the desk of every reviewer—literary or medical. "A fair and appreciative estimate of a book, one that indicates, without detraction the author's purpose and achievement is of positive value to the public and just to the literary work under consideration. The old-fashioned review that is witty at the expense of the author, or that annihilates the latter with sledge-hammer blows to the infinite satisfaction of the executioner, if not to his victim, is rapidly growing in disrepute. A stricter sense of justice demands that a fair field should be shown an author an exact estimate of his book furnished a reading public that,

in this connection, may be in the attitude of a prospective buyer. The informative rather than the purely critical review, the review guided by personal opinion, becomes thus the most useful to the latter. Impartiality is better worth cultivating as a practical asset in the rendering of literary judgment than stark censoriousness. After all, Bacon's famous rule holds for reviewers equally with readers of books. "Read not to contradict or to confute, not to believe and take for granted, but to weigh and consider."

Even if this bit of editorial wisdom had escaped my eye, the books of the month would themselves have served to stimulate the thoughts already expressed, for among them are two volumes which if viewed narrowly, might inspire a spirit of unfair disagreement and call forth double edged phrases of stiletto keenness.

Take for example this newest volume by Crile on *A Mechanistic View of War and Peace*. I might have summarized the volume by saying that it is small, handy, and attractive, and that in six chapters it attempts to expound the thesis that war is brewed by formula not totally unlike the mathematical formula governing the angles of incidence and reflection. This thesis is stated in a short introductory chapter. The second chapter, I might have explained deals with "The Phenomena of War" and expounds such shibboleths as, "Integration of the Community" and "Kinetic System," together with such more material phenomena as artillery fire, trench fighting, the charge, retreat, fatigue, pain, courage, loss of sleep, wounds, and causes of death. Chapter III, I might have gone on to add, is devoted to the very commonplace deduction that man has risen through the unnumerable ages by struggle, and that present day war is the evolutionary vestigial evidence of former almost constant battling. Chapter IV, "A Mechanistic View of German Kultur," I might have characterized as a bold attempt to explain the working of German kultur on the basis of its analogy to the ant colony (Crile says these two types of kultur are identical), and then I might have pointed out smugly the cleverness with which Crile cuts the Gordian knot; for while other astute minds are painfully laboring to show that German kultur is the mark of either the superman or the devil, Crile clearly shows that the lowly ant is the typical representative. Then I might

A MECHANISTIC VIEW OF WAR AND PEACE By George W. Crile
M.D. New York: The Macmillan Company 1915

continue the analysis with tender sarcasm and say that chapter v, "A Mechanistic View of the Visitation of Belgium," proves that the reason why Liege and Namur had to be blown up was because the brain, liver, adrenals, and thyroids of the Belgians yielded under the strain of emotional excitement, and finally I might have concluded with the statement that the closing chapter on "Evolution Toward Peace" is based on the astounding statement that the mechanistic doctrine "fixes all responsibility for human action here and now, within oneself."

I say advisedly, *I might have done all this*. I am an avowed — though qualified — antimechanist and I might, very conceivably, in antimechanistic heat, have set about deliberately to shatter what impressed me as a weak argument. But in so doing I should have disregarded Dr Crile's own modest disclaimer of any "special knowledge of philosophy or psychology." I should have slurred over the essential ingenuity involved in the admirably keen analysis of the behavior of man under the actual stress of war. Crile's unique fitness to correlate the laboratory and the ward, and his pervasively insinuating personality. Finally, I should have fallen inestimably far short in failing to point out the significance to surgery, of a man who, in the language of Claude Bernard, clothes himself in his imagination. Indeed, I should have had a debit account of so many sins of omission that I should have been ashamed to father the review. How much better and sadder to recognize all these excellencies and to recommend the book as a stimulating volume!

AFTER one has spent about three solid evenings in going through this mammoth volume of Brophy's on *Oral Surgery*,¹ carefully noting on fly leaves and margins the deficiencies and points of excellence, he comes to the conclusion that in this instance also it would be easy to play the part of the village harper and point out with autocratic acumen how the task of the author could have been better performed. For instance there is a strong over-emphasis of surgical principles, even considering the book as a *read mecum* for dentists (fractures of the long bones are dragged into the text literally by the scruff of the neck). Not infrequently symptoms are inadequately described, as in the various diseases of the tongue, and operative treatment not clearly expounded, as in that portion devoted to mandibular ankylosis. If one desires specific information regarding the diagnosis and treatment of the interesting group of giant cell sarcoma of the lower jaw, he will find his desire far from gratified.

On the other hand, if one stops to think of Dr Brophy as the practical founder and militant ex-

ponent and champion of oral surgery in the United States, and if one considers how much we general surgeons owe him on that score, and if one then further considers that the volume is not only the product of an unusually ripe clinical experience but also is the result of twenty-five years of planning, the thought is driven home that these things constitute the spirit of the work. With this point of view, caviling criticism has no place and only hearty praise finds expression.

The book is eleven hundred pages thick, and by its very bulk defies detailed criticism. Nearly one-fourth of the work is devoted to surgical principles: surgical bacteriology, special infections, syphilis, tuberculosis, immunity, tumors, wounds, assepsis, etc. There is an excellent chapter on the surgical engine by Dr M. H. Cryer — a chapter that would be of more universal interest to surgeons, were it not for the latter-day development of the more compact electric motors. Following this chapter, there are discussed in order the following subjects: Infections of oral origin, the tongue, tonsils, and adenoids, embryology, anatomy, and physiology of the mouth, fractures of the bones of the face, dislocation of the mandible, diseases of the mouth, ankylosis of the temporomaxillary articulation, antrum of Highmore, harelip, cleft palate, the training of speech after cleft palate operations, plastic surgery, dento alveolitis, extraction of teeth, transplantation of teeth, cysts, maxillary and mandibular tumors, trigeminal neuralgia, the salivary glands, eugenics, prosthesis, infant feeding, ligation of arteries (carotids, lingual, facial, temporal, coronary), prognathism, diseases of the lips.

For those of us who have followed Dr Brophy's writings on harelip and cleft palate, not the least valuable attribute of the work lies in the concrete presentation of his views between two covers. The greatest value of the book lies in the indispensable part it plays in rounding out that portion of the library devoted to oral surgery.

IT has not been so very long ago that we commented on the appearance of a large number of excellent treatises on operative surgery. We had in mind at that time the reservation that our preference for our *Jacobson* was still largely unqualified. Now that a new up-to-date revision has appeared, we stand the two new volumes² shoulder to shoulder with even bulkier and more pretentious systems of operative surgery. Unfortunately, Mr Jacobson himself took no part in the revision of the sixth edition, and yet one must admit that the work of Messrs Rowlands and Turner has been so well done that one scarcely misses the author's guiding hand.

Regarding format, very little is to be added to our comments on the preceding edition. Each of the two volumes has been increased very appreciably in size, and the arrangement has been altered so as to

¹ ORAL SURGERY. A TREATISE ON THE DISEASES, INJURIES, AND MALFORMATIONS OF THE MOUTH AND ASSOCIATED PARTS. By Truman W. Brophy, M.D., D.D.S., LL.D. With Special Chapters by M. H. Cryer, M.D., G. H. Makuen, M.D., W. J. Younger, M.D., F. W. Belknap, M.D., C. S. Case, M.D., D.D.S. Philadelphia: F. Blakiston's Son & Co. 1915.

² THE OPERATIONS OF SURGERY (Jacobson). Sixth Edition by R. P. Rowlands, M.S., F.R.C.S., and Philip Turner, B.Sc., M.S., F.R.C.S. New York: The Macmillan Company, 1915.

reserve the second volume exclusively for abdominal surgery. Volume I is devoted to the head, neck, spine, thorax, upper and lower extremity. The old order of careful, almost didactic consideration of indications, contra indications, dangers, and results is preserved, and it constitutes not the least part of the large value of the work. Indeed this, with the strong personal tone that pervades every page places the work in a class by itself. In the first volume, I have looked in vain for statements to which one might take specific exception, such as might be characterized as dissent. It is impossible, of course, to note seriatim the various descriptions. One misses with some surprise, a discussion of any of the newer operations for arthroplasty, and with equal surprise notes the absence of discussion of alcohol injections for trigeminal neuralgia. The general principles underlying the formation of good weight-bearing amputation stumps, and the detailed post-operative care of stumps are not accorded the space and attention that is warranted by the newer literature on this subject. In reading through the chapters devoted to chest surgery, one gains the very definite impression that the editors do not fully appreciate the scope and value of intratracheal anesthesia. The method is described accurately, it is true, but it is not recommended in most of the operations on the mouth, pharynx, and air passages.

Volume II deals with hernia, peritonitis, gastrotomy and gastrotomy after much the method as

was followed in the preceding edition. One notes, merely in passing, that the editors have adopted the inguinal route operation for femoral hernia as the rational procedure. The next chapters on the surgery of gastric and duodenal ulcer are classical condensations of the very best opinions of the day. One almost feels tempted to say that every surgeon should set, as a self-imposed task, the reading of these chapters. Intestinal surgery is handled next, and one finds here, in chapter xxii, a full exposition of intestinal stasis. We feel that too much space has been devoted to this subject (forty pages) when we consider that practically all of the subject matter is quoted literally from Lane's work and introduced by the editors with the laconic sentence, "Time will prove whether these views are right or not." The chapter on splenectomy is interesting in that, although splenectomy is recommended in Banti's disease and splenic anemia, no mention is made of it as a therapeutic procedure in pernicious anemia or hemolytic icterus. It is difficult to determine, however, whether the authors might not intend to include hemolytic icterus under the generic term of splenic anemia. The chapter devoted to the rectum is particularly well done, the editors showing the uncommonly good judgment, for instance of incorporating Miles' description of the combined operation for cancer of the rectum.

A large sale of a work such as this can only work for the ultimate good of surgery.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE ROENTGEN DIAGNOSIS OF SURGICAL LESIONS OF THE GASTRO-INTESTINAL TRACT. By Anil W. George, M.D., and Ralph D. Leonard, A.B., M.D. Boston: The Colonial Medical Press, 1915.

THE AMERICAN ILLUSTRATED MEDICAL DICTIONARY. Eighth edition. By W. A. Newman. Dordrecht, A.M., M.D., I.A.C.S. Philadelphia and London: W. B. Saunders Company, 1915.

AN INTRODUCTION TO BACTERIOLOGY FOR NURSES. By Harry W. Carey, A.B., M.D. Philadelphia: J. A. Davis Company, 1915.

THE MEDICAL CLINICS OF CHICAGO. November, 1915. Philadelphia and London: W. B. Saunders Company, 1915.

LIPPINCOTT'S NEW MEDICAL DICTIONARY. THIRD EDITION. By Henry W. Catteff, A.M., M.D. Philadelphia and London: J. B. Lippincott Company, 1913.

THEORY AND PRACTICE OF BLOODLETTING. By Henry Stern, M.D., LL.D. New York: Rebman Company, 1915.

HOSPITALS AND THE LAW. By Edwin Valentine Mitchell, LL.D. New York: Rebman Company, 1915.

THE OBSTETRICAL QUIZ FOR NURSES. A MONOGRAPH ON OBSTETRICS FOR THE GRADUATE AND THE UNDERGRADUATE NURSE IN THE LIVING ROOM. By Hilda Elizabeth Carlson. New York: Rebman Company, 1915.

YOUR BABY, A GUIDE TO MOTHERS. By E. B. Lowry. M.D. Chicago: Forbes & Company, 1915.

COLON HYGIENE. By J. H. Kellogg, M.D., LL.D. Battle Creek, Michigan: Good Health Publishing Company, 1915.

ENCYCLOPEDIA MEDICA. Second edition. Under general editorship of J. W. Ballantyne, M.D., C.M., F.R.C.P. Vols. I and II. New York: The Macmillan Company, 1915.

SPEAKING OF OPERATIONS. By Irvin S. Cobb. New York: George H. Doran Company, 1915.

Clinical Congress of Surgeons of North America

SEVENTH ANNUAL SESSION

PHILADELPHIA

OCTOBER 23 TO 28, 1916

CLINICAL CONGRESS OF SURGEONS OF NORTH AMERICA

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PLANS FOR THE PHILADELPHIA MEETING

UNDER the leadership of Dr. Robert G. LeConte as Chairman of the Committee on Arrangements, the clinicians of Philadelphia are working out plans for the seventh session of the Congress to be held in Philadelphia the week of October 23, 1916. It may be confidently assumed at the beginning that Philadelphia with its numerous large hospitals and well organized clinical facilities will be able to provide a program of unusual interest. Those members of the Congress who were privileged to attend the second session held in Philadelphia in November, 1911, will recall with great pleasure the splendid program of clinics offered by the Philadelphia surgeons at that time and will look forward with interest to a second opportunity of visiting that city. Before the next issue of this journal goes to press it is expected the work of the committee will have progressed so that a preliminary schedule of clinics and demonstrations may be published, together with the personnel of the committee on arrangements.

The Executive Committee of the Congress is in a position to make the following announcement as regards the general plans for the next meeting. Headquarters will be established at the Bellevue-Stratford where the ballroom, Clover Room, Red Room, Green Room, and adjacent foyer and smaller rooms have been reserved for the use of the Congress. These rooms are lo-

cated on the second floor of the hotel and provide ample space for registration and ticket bureaus, bulletin boards, etc., the Ballroom being used for the evening meetings. A large number of members can be accommodated at this hotel, while other first class hotels, located within two or three blocks of headquarters, can accommodate the remainder of the members.

In accordance with the precedent established at the meeting in London in 1914 and carried out at the Boston session in October, 1915, attendance at this session will be limited in number. A careful survey of the operating amphitheaters, lecture rooms, and laboratories in the hospitals and medical schools, as to their capacity for accommodating visiting surgeons, will be made and the limit of attendance will be based thereon. This plan insures accommodations at the clinics for each one who receives a membership card. In addition attendance at all clinics and demonstrations will be controlled by means of special tickets, the number of tickets issued for any clinic being limited to the ascertained capacity of the room in which the clinic is given.

Later in the year a formal announcement of the plans for the Philadelphia session together with an invitation will be sent to all members of the Congress and advance registrations will then be accepted in the order of their receipt up to the limit of attendance which will be fixed. The

popularity of these clinical meetings has become so great that this plan of limiting the attendance and requiring advance registration, which has worked so satisfactorily at the two previous sessions, has been adopted as a rule for all succeeding sessions of the Congress.

The general plan of the Congress will include clinical demonstrations, operative and non-operative, in every department of surgery, including gynecology, obstetrics, genito-urinary surgery, orthopedics, roentgenology, surgery of the eye, ear, nose, and throat, surgical pathology, etc. The clinical demonstrations at the hospital- and

medical schools will occupy the hours from 9 to 5 of each day, while the evenings will be devoted to sessions at which eminent surgeons will read and discuss papers dealing with subjects of present-day interest.

There are no annual dues for members of the Congress. The constitution provides that a registration fee shall be required of each member attending an annual meeting. These fees provide the funds to meet the expenses of preparing for and conducting the annual meetings, so that no financial burden will be imposed upon the profession in the city entertaining the Congress.

SURGERY, GYNECOLOGY AND OBSTETRICS

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NUMBER 3

THE OPERATIVE TREATMENT OF PYLORIC OBSTRUCTION IN INFANTS

WITH A REVIEW OF SIXTY-SIX PERSONAL CASES¹

By WILLIAM A. DOWNS, M.D., F.A.C.S., NEW YORK

IN April, 1914, the writer reported the operative results obtained in 22 cases of pyloric obstruction in infants. At that time the symptoms of the disease were given as were measures necessary to establish the diagnosis, and reasons were stated which seemed sufficient to justify the opinion that surgical intervention was indicated in every case in which definite obstruction was present or seemed imminent.

Since that report was made, 44 additional cases of this disease have come under my care, making a total of 66 cases, observed in five and one-half years. This added experience has in many ways been a source of much gratification, but has not been without its disappointments. To begin with it has not enabled us to add anything new to the etiology or pathology of the disease, notwithstanding the fact that partial or complete necropsy was obtained in every case dying in the hospital.

With one exception there was the characteristic tumor at the pylorus. All showed marked hypertrophy of the band of circular muscle fibers with the redundant and thickened mucous membrane lying in longitudinal folds. The tumor in the single exception noted above while of considerable size was less firm, and the incised muscle not more than

half as thick as in the average case. These differences were noted, but were not properly interpreted. The baby continued to vomit after operation and died in 18 hours. At necropsy, Dr. Martha Wollstein, Pathologist to the Babies' Hospital, discovered a small tumor, originating in the muscularis mucosa, projecting into and filling the lumen of the pylorus (Figs. 1 and 2).

Most of the stomachs were of an average size, a few very large and two or three very small, one was so small that it would hold only 1 ounce. Edema in varying degrees involving the pylorus and pyloric region of the stomach was present in all cases, and in a few instances it was present throughout the stomach wall. We believe the presence of this edema plays a very important rôle and is the factor which determines the definite onset of symptoms.

The theory that best explains the sequence of events in this disease is that a true malformation is present at birth consisting of an abnormal thickening of the circular muscle of the pylorus, and that the effort necessary to force food through the narrowed and elongated pyloric lumen produces circulatory disturbance resulting in edema. As the food is increased in amount and the muscular effort becomes greater the lumen narrows down until

¹ Read before The Southern Surgical and Gynecological Association, Cincinnati, December 13-15, 1915.

finally at the tenth day or a little later it becomes more or less completely obstructed. In support of this theory I would call attention to the fact that, after the symptoms have developed, a reduction in the amount of food with consequent relief of muscular effort, together with systematic stomach washing which removes curd and mucus will often give temporary relief and in an exceptional case if the muscular hypertrophy is not too extensive carry the child along for a time. However, as the food is again increased all the symptoms recur.

In Case 7, typical symptoms began at 5 weeks, which under careful feeding and lavage subsided in a few days, and the child began to gain, 3 weeks later however after increased feedings, there was a recurrence with sudden marked depression requiring immediate operation.

As shown by Holt, definite persistent pyloric spasm without hypertrophy has yet to be proved. This author prefers to divide cases showing the symptom complex under discussion into mild and severe types, and recommends that the term 'pylorospasm' be discarded. Unquestionably there is a definite element of spasm in these cases, but it is the result and not the cause of the hypertrophy.

SYMPTOMS

The group of symptoms which go to make the diagnosis is projectile vomiting, tumor, peristaltic waves, gastric retention and rapid loss of weight. Marked constipation is usually present, although a 'starvation stool' or even one containing milk may occur from time to time depending entirely upon the degree of obstruction. So much has already been said in reference to the symptoms and diagnostic signs that I will take up but one and that is the question of tumor.

In every case here reported the presence of a tumor described as varying in size from the terminal phalanx of the little finger to that of the thumb was noted by at least two or more observers and so charted before operation. In a few instances where there was some doubt owing to difficulties in palpation, light anaesthesia (ethyl chloride inhalation)

was required. This procedure is simple and the information of such value that any slight risk is more than offset. Before administering the anesthetic a tube should be passed to the stomach. This removes the gas and makes it much easier to palpate the tumor which lies to the right and above the umbilicus. I consider the presence of this so-called tumor pathognomonic of the disease. The various house physicians at the Babies' Hospital, where most of the cases were observed have expressed the same view. The diagnosis based upon this sign alone was frequently made by them in the admitting room.

Those who state that a tumor can be found in a small percentage of cases only, have either seen too few patients with this disease for their opinion to be of value, or else have failed to make a proper examination. That vomiting, loss of weight, retention, and all the symptoms of high obstruction in the alimentary canal may occur without a palpable tumor at the pylorus there is no doubt. One such case was operated upon at the Babies' Hospital, in which a heavy peritoneal band passed from a loop of the ileum across the hepatic flexure of the colon and was adherent to the duodenum in such a way as to cause complete obstruction (Fig. 3). Without operation or necropsy this case might have been recorded as one of pyloric obstruction in which no tumor existed.

OPERATIVE TREATMENT

Obstruction at the pylorus is just as definitely an obstruction of the intestinal tract as that situated at any other part of the canal. It belongs to the obstruction type which is without strangulation and is therefore without the totality of the more acute form. The sudden marked depression with collapse and death seen in the neglected cases is not toxic in character but the result of starvation. With this knowledge of the disease it would seem that the rational treatment to adopt is that designed to relieve the cause of the obstruction at the earliest possible moment.

Until within recent years the operative results in pyloric obstruction were so uncertain that physicians did not feel justified



Tumor occupying pyloric opening

Fig. 1 Tumor occupying pyloric opening (From sketch made at time of necropsy)

in recommending surgical treatment. Now that the disease is better understood and the operative technique greatly improved these objections no longer hold. Under the most favorable conditions and in the best hands cases treated medically are long drawn out — 10 to 12 weeks or even longer — with the result always in doubt, and the knowledge ever present that without the slightest warning the baby may go into collapse and die, even though its progress had been favorable.

At the present time the opinion of most pediatricians with unbiased minds is almost a unit as to the necessity of operation in these cases once the diagnosis is established. In the cases seen and diagnosed early, some feel that a few days of careful observation with proper feeding and lavage, is justified with the hope that the symptoms may subside, others advise immediate operation in every case. All agree that most cases surviving operation make a rapid and satisfactory recovery.

A number of operative procedures have been resorted to in the surgical treatment of pyloric obstruction, only two of which, however, postero-gastro-enterostomy and partial pyloroplasty have given results sufficiently satisfactory to warrant adoption.

So far as I know the largest individual series of cases operated on heretofore reported have been those of Richter, Scudder, and myself. Postero-gastro-enterostomy was the procedure adopted by each of us and the mortality rate was 14 per cent, 24 per cent, and 32 per cent respectively. The total number of cases in these 3 series was 61, with a mortality of 22 per cent. This was a much lower rate than any previously recorded for

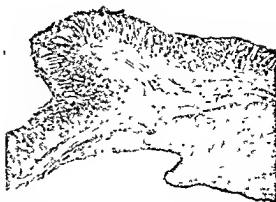


Fig. 2 Cross section of tumor arising from muscularis mucosae, shown in Figure 1

so large a number of cases. In my own hands, the mortality following gastro-enterostomy continued above 30 per cent. This was due in part to the critical condition of the infants at the time of admission to the hospital. Operation was refused in no case, but there were a number of deaths which could not be attributed wholly to the condition of the babies. It was the effort to avoid seemingly uncontrollable fatal complications which occurred late in the convalescence of these babies that caused us to give up gastro-enterostomy at least for the time being. Therefore, in October, 1914, we decided to give the so-called partial pyloroplasty of Rammstedt a thorough trial, and our results have been more satisfactory since that date. Of the 66 infants included in this report 31 had a gastro-enterostomy done, and 35 were operated on according to the method of Rammstedt (Figs. 4 and 5). The operation in 19 of those done by the latter method was modified to the extent of passing a sound through the pylorus after the muscle had been divided. The sound was introduced through a small incision made in the stomach wall some distance from the pylorus. This procedure is similar to that recommended by Keefe with the exception that the sound is passed after the circular muscle is divided and not before (Fig. 6).

The gastro-enterostomies were done according to the posterior no-loop method,

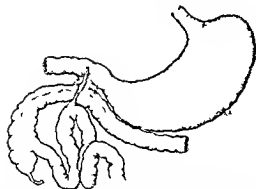


Fig 3 Peritoneal band passing from ileum across hepatic flexure and adherent to duodenum causing obstruction



Fig 4 First step of Rammstedt operation. Tumor supported. Line of incision shown

with the exception of the first 2 cases where clamps were not used. The duration of operation varied from 25 to 45 minutes. The partial pyloroplasty or "nicking of the circular muscle fibers" consisted in making a longitudinal incision from 2 to 3 cm. in length through the serosa and the hypertrophied circular muscle fibers of the pylorus down to the thickened mucosa. Duration of operation 10 to 20 minutes. In performing this operation the pyloric tumor should be held firmly between the thumb and index finger, and as the incision is deepened the edges of the wound gently forced apart. After the muscle is cut through, a definite line of cleavage is seen to exist between the muscle and the mucous membrane. A small pair of blunt pointed, curved scissors may be used to advantage in spreading the incision. When the muscle is sufficiently divided the liberated mucous membrane protrudes freely into the wound. There is very little hemorrhage — occasionally a small vessel may require a ligature — but as a rule the application of hot pads to the edges of the wound for a few minutes controls the bleeding. This completes the operation. The tumor is dropped back into the abdomen and the wound is closed.

In spreading the incision and separating the muscle from the mucous membrane it is best to start from the stomach end of the incision, as here the merging of stomach wall into pyloric tumor is a gradual one, and there is not much danger of opening the mucous

membrane, whereas, the change from the thickened and redematous pylorus to normal duodenum is so sudden that extreme care is necessary, in order to avoid opening the intestine at this point. On account of this accident some operators have discarded this operation and have returned to gastro-enterostomy. It occurred twice early in our series, but fortunately the openings were small and very easily closed and no bad effect followed. It is not necessary to cover the incision at the pylorus with omentum, or to attempt its closure with flaps from the muscle, nor should the effort be made to close the wound by converting the longitudinal into a transverse incision. It is very difficult to get sutures to hold in this tissue, and besides there is risk of again narrowing the lumen. The fact that the mucous membrane did not give way in one of our 35 cases is sufficient proof that any effort to reinforce the wound is unnecessary.

For fear that simple division of the hypertrophied circular muscle-fibers did not quite meet all the indications in these cases, I decided to modify the operation as already stated. This was done 19 times, and in every case a No. 20 sound (French scale) was passed through the pylorus without the slightest resistance. The cases in which this modification of the Rammstedt operation was done did no better than those operated on by the simpler method, and it was soon discarded, not, however, until one and possibly two fatalities resulted from its use. At



Fig 5 Second step showing completed operation

times it was very difficult in the small thick-walled stomachs to properly close the incision made for the passage of the sound. In one instance a stitch gave way and the baby died of peritonitis. A second case of peritonitis occurred where this method was used, and it is very likely the infection resulted from the incision into the stomach although no leakage could be discovered at necropsy.

RESULTS

The general condition of the babies subjected to the two operative procedures—gastro-enterostomy and partial pyloroplasty—averaged much the same. Several in each group were almost moribund at the time of operation. The stimulating effect of ether and the value of hypodermoclysis is well shown in these cases as most of them were in as good condition at the close of the operation as they had been at the beginning. All cases survived the immediate effect of operation, the earliest death occurring in 3 hours. The smallest baby in the entire series weighed 3 pounds 15 ounces, the largest 9 pounds 9 ounces, average weight 6 pounds 8 ounces. The smallest baby recovering after gastro-enterostomy weighed 5 pounds, and after the Rammstedt operation 4 pounds. The average age for the series was 6 weeks, youngest 3 weeks, oldest 20 weeks. Of the 31 cases in which gastro-enterostomy was performed, 11 died, giving a mortality of 35 per cent, 2 died as a direct result of faulty technique, 3 died

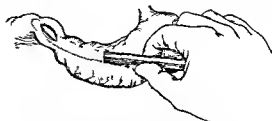


Fig 6 Modified Rammstedt operation. Sound passed through pylorus after circular muscle has been divided. (This modification has been discontinued.)

in a few hours, and 6 died in from 5 to 19 days after operation. Of the 20 cases discharged as cured 2 died within a short time from acute gastro enteritis, and 1 died in 3 months from diphtheria. The remaining 17 cases are alive at the present time, all are well and have developed normally in every way.

So far as I can find out no late complications have followed the gastro enterostomy. Roentgen ray examination of several of the cases from one to three years after operation shows that the stomata are working satisfactorily and that little or no bismuth passes the pylorus, thus proving that the obstruction is permanent and that it is not influenced by this type of operation. The latter observation is also borne out by the fact that at necropsy in the case dying 3 months after operation the tumor was unchanged. It is only fair to say that the 3 cases dying shortly after operation were in extremis, and it is doubtful if the final result was influenced to any appreciable degree by the operation. It is to the group of 6 cases dying from 5 to 19 days after operation that I wish to call special attention. 1 died on the fifth day of acute nephritis, 3 cases continued to vomit moderately for a few days, gradually growing worse until death which took place on the sixth, fifteenth, and nineteenth days. The case dying on the fifteenth day was re-operated on shortly before it died, but no cause for the continued vomiting could be found. Necropsy in the other 2 cases likewise failed to explain the persistence of the symptoms. The two remaining cases developed diarrhea, became depressed, and in spite of every effort died in from 10 to 12 days. In none of these cases did post mortem

examination show peritonitis or in any way explain the fatal result with the exception of the one case dying of nephritis. The anastomoses were properly located, had healed, but in 3 cases failed to functionate as they should. It is on account of this unfortunate experience which is without satisfactory explanation that we decided to try other measures for the relief of pyloric obstruction.

Of the 35 partial pyloroplasties, 1 was done in April, 1914, and has been previously reported, 1 was operated upon the following May, and the rest since October, 1914. Eight deaths occurred in this series, a mortality of 23 per cent. Two died of peritonitis following the modified operation as already mentioned. One died 20 hours after operation with symptoms unrelieved, and necropsy showed a small tumor arising from the muscularis mucosa completely blocking the pylorus. Four cases died in from 4 to 27 hours—all were practically moribund and the result was to be expected. One died of inanition on the twenty-sixth day, when this baby was given more than 1 ounce of food it would vomit. The smallest and thickest walled stomach yet observed by us was found at necropsy in this case. The pylorus was patent. There were discharged as cured 27 cases. Of these 1 died in a convulsion some 10 days after leaving the hospital; up to a few hours before death its condition had been excellent. Post-mortem examination not obtained. One case returned to the hospital 3 months after operation suffering from endocarditis and pericarditis from which it died. The stomach removed at necropsy showed an elliptical cicatrix on the anterior surface of the pylorus about one-half the size of the original wound. This area was covered with serosa and appeared to be composed of serous and mucous coats only. The remaining portion of the pylorus was somewhat thicker than normal, but the tumor which had been "a typical one of moderate size" had almost entirely disappeared.

The other 25 cases have been kept under close observation and are in good condition. They have all gained rapidly and many of them are above their normal weight, in no case has there been a return of the symptoms.

Röntgen examination has been made of 4 cases from 6 months to 1 year six months after operation, and the stomachs have much the same appearance as those of other babies. They empty more slowly than the gastro-enterostomy cases, but at about the normal rate.

POST-OPERATIVE TREATMENT

The cases operated on by the method of Rammstedt required less stimulation and reacted more quickly than those in which gastro-enterostomy was done. Vomiting was less frequent and smaller in amounts than after the latter procedure. All cases surviving partial pyloroplasty began to improve rapidly after the second or third day, some had setbacks and a few were difficult feeding cases, but as a rule they were much less trouble to feed than the gastro-enterostomies. A number of the latter developed a diarrhoea in from a week to 10 days, which was difficult to control and in 2 instances proved fatal. The pyloroplastic cases did not show this tendency and I believe the explanation lies in the fact that the food passing out of the stomach through the natural channel at a normal rate has less tendency to cause intestinal disturbance than when it passes through the artificial opening at a rate which in many instances, as shown by X ray, is much too rapid.

Feeding is begun in the Rammstedt cases in about 2 hours, 2 to 3 drams of breast milk, alternating with water, is given every 2 hours to start with, and this is rapidly increased so they are getting from 1 to 1.5 ounces every 3 hours at the end of the second day. The gastro-enterostomy cases required more care in their feeding and tolerated the rapid increase in amount less well than did the other class of cases.

CONCLUSION

I have gone somewhat into detail in comparing the results obtained in the use of gastro-enterostomy and partial pyloroplasty in the treatment of pyloric obstruction, in order to bring out the advantages as well as the disadvantages of each method. From the foregoing it seems fair to say that partial pyloroplasty has many advantages over gastro-enterostomy. The time required

to do the former operation is less than half that required to perform the latter, reaction is more prompt, feeding is begun earlier and can be pushed more rapidly, post-operative vomiting is less and late complications such as diarrhea and unexplained vomiting do not occur

The operation is simple, requires much less surgical skill than gastro enterostomy, and most important of all the obstruction is permanently removed and the normal continuity of the alimentary tract is preserved. Specimen removed from the case dying 3 months after operation and roentgen examination one and one half years after operation prove the accuracy of this statement

The method is open to the criticism that it leaves an uncovered wound, that the abdominal cavity is protected from contamination only by a thin layer of mucous membrane, and that as the scar contracts the obstruction will reform. I believe the excellent results obtained by other surgeons using this method together with those here recorded prove these criticisms to be largely theoretical. The danger of opening the mucous membrane is a

real one, but with care should be avoided. To the above objections may be added the fact that in our unique case of tumor blocking the pyloric lumen this type of operation was inadequate. If a little more care had been exercised in examining the pylorus in this case the cause of obstruction would probably have been discovered. It is needless to say that a gastro enterostomy should be added if in any case there is reason to suspect that the lumen of the pylorus does not become patent after division of the circular muscle.

Continued experience and longer observation of the cases may bring out other more serious objections to partial pyloroplasty, but until that time, or until something better is proposed, operation according to the method of Rammstedt should be the one of choice in the treatment of pyloric obstruction in infants.

Finally, the success or failure of either operative procedure is determined in a large measure by the length of time lapsing between the onset of symptoms and the time of operation.



Fig 2 Apparently discrete myomatous nodules in an adenomyoma of the round ligament. Gyn Path No 10 018. The greater part of the specimen stains diffusely. It consists chiefly of fibrous tissue and contains non striped muscle. It will be noted that the adipose tissue at the bottom is being irregularly replaced by fibrous tissue. There are three distinct areas that have a whorled appearance. They form a roughly triangle in the picture. These areas are very cellular and closely resemble young myomata. They may possibly however be very cellular areas of the characteristic stroma that usually surrounds uterine glands.



Fig 3 Adenomyoma of the round ligament. Gyn Path No 10 018. The solid portion of the specimen consists of non striped muscle and fibrous tissue. A little below the center of the field is a gland lined with one layer of cylindrical epithelium. In some places it is separated from the tumor proper by a definite stroma.

Projecting from the surface on the right of the specimen is a dome shaped mass of tissue very rich in cells with oval nuclei. This tissue is identical in every way with the characteristic stroma of the uterine mucosa. In the lower part it contains a small gland lined with one layer of cylindrical epithelium. The surface of this dome shaped mass of stroma is covered over with one layer of cylindrical epithelium.

The entire picture is that of a typical adenomyoma. The dome-shaped mass of mucosa evidently projected into one of the cyst cavities noted macroscopically.

over a considerable area. The adhesions were gradually loosened and the raw area on the bowel was closed. The lumen was not injured. I then examined the omentum and found that it passed down through a hernial opening near the right internal inguinal ring and then directly out into the adipose tissue of the anterior abdominal wall. The omentum was cut off at the internal ring tied, and pushed out of the way. The extraperitoneal portion of the omentum was left undisturbed. The peritoneum over the internal ring was now closed from within. I then removed the appendix which showed evidence of old inflammation there being present adhesions passing off from it in various directions.

After closing the abdomen I made an incision over the tumor in the right inguinal region. This

tumor was adherent to the skin. The skin was dissected back and the mass literally cut away from the fascia. There were numerous cysts some filled with clear contents others with a slightly turbid fluid, and quite a number with chocolate colored fluid strongly suggesting adenomyoma. Adenomyoma was considered probable, some stress being laid upon the declaration of the patient that the lump appeared to increase in size at each menstrual period. After dissecting away the lower portion of the tumor which was also adherent to the fascia, I now lifted up the omentum from the hernial opening. The hole left near the internal ring was slit like in form, about 1 cm long and 4 mm broad. It was closed with kangaroo tendon. To dissect back the fascia and do an orthodox operation



Fig. 4. The lining of a cyst in an adenomyoma of the round ligament. Gyn Path No 19018. The tumor consists of fibrous tissue and non-striped muscle. The inner surface of this cyst was undulating and had numerous depressions running off from it. These depressions may with equal propriety be described as glands. The cyst is lined with one layer of cylindrical epithelium, which at the more prominent or exposed points has become cuboidal.

was out of the question because of the large defect that would have been left. At most points good firm scar tissue existed. I closed the wound with through and through silk-worm gut sutures; accurate skin approximation was made with fine black silk. The lower angle of the wound was drained with protective. The patient made a good recovery.

On December 8, 1915, Dr. Trout wrote me, saying that he had just spoken to the patient. She has had no return of the trouble, is free from pain, and has gained twenty pounds.

Gyn Path No 19018. The outlying portion of the tumor consisted of fat with here and there yellowish or brownish pigmentation suggesting the pigment of old hemorrhage. The central portion of the tumor closely resembled fibrous tissue. It

had cystic spaces scattered throughout it. The contents of these varied, as noted above, some being clear, others turbid and some being filled with chocolate like material.

Histological examination. The outlying portion of the specimen consisted of adipose tissue. As one passed toward the tumor, the fat was gradually and irregularly replaced by fibrous tissue, which in many places had undergone almost complete hyaline transformation. Scattered here and there throughout the fibrous tissue were large or small areas of non-striped muscle. Several very small discrete myomata were also noted (Fig. 2). At numerous points in the tumor were glands, tubular or round and lined with one layer of cylindrical epithelium (Fig. 3). Some of the glands lay in direct contact with the fibrous tissue or muscle, others were separated from the tumor by the characteristic stroma of the mucosa. The cyst spaces noted macroscopically were lined with one layer of cylindrical epithelium (Fig. 4).

From the description it is perfectly clear that this was an adenomyoma of the round ligament associated with a large amount of fibrous tissue. From a clinical standpoint the coexistence of a small inguinal hernia with incarcerated omentum and an adenomyoma of the round ligament is very interesting. The increase in size of the inguinal nodule at the period naturally made me suspicious of adenomyoma and the indications supplied by the presence of old pigment in the fat at operation, coupled with the fact that some cysts contained chocolate like material justified a tentative diagnosis that the tumor was an adenomyoma even before the microscopical examination. I have not as yet gone over the recent literature, but do not know of any other case in which an inguinal hernia and an adenomyoma were found in the same hernial protrusion.

EARLY TUBERCULOSIS OF THE CERVIX¹

BY THOMAS S. CULLEN, M.B., F.A.C.S., BALTIMORE, MARYLAND

A FEW weeks ago, when taking up diseases of the cervix with my class in Gynecological Pathology at the Johns Hopkins Hospital, we encountered the following striking example of very early tuberculosis of the cervix.

Gyn Nos 19 334 and 20,660 The patient, a healthy looking colored woman 25 years of age, was admitted to the Johns Hopkins Hospital on October 16 1914 complaining that she had been discharging fecal matter through the vagina for two years. She had been married six years but had never been

The bladder and tube were freed and the fistula between the vagina and rectum was cut across. The small opening in the sigmoid was closed. The uterus which contained several myomata was now removed, a complete hysterectomy being done.

The laboratory diagnosis was *bilateral follicular salpingitis, uterine myomata, tuberculosis of the endometrium, tuberculosis of the cervix*.

The photograph of an area from the section of the cervix shows at each outer portion of the picture normal squamous epithelium with a normal underlying stroma. In the center, the superficial portion of the squamous epithelium is still intact, the underlying layers of epithelium are missing, and a cres-



Gyn Nos 19 334 and 20 660 Gyn Path No 20 640 The tuberculous process was much more advanced in the mucosa lining the cavity of the uterus than in the cervix. The cervical mucosa is intact. In the center of the field is a well-defined tubercle consisting of epithelioid cells and containing giant cells of various types. Between the tubercle and the overlying squamous epithelium is a crescentic space filled with blood. The stroma to the left of the tubercle shows some small round cell infiltration.

pregnant. Her menses had begun at 19 but for the last five years she had had no periods.

At operation Dr J. Craig Neel, the resident gynecologist, found the uterus in retroposition and the bladder adherent to it above the internal os. The sigmoid was adherent to the vesico-uterine reflection just above the level of the internal os. The right tube and ovary had become twisted over the anterior surface of the uterus.

centic space is seen filled with blood. Immediately beneath this is a tubercle occupying partly the epithelial layer and partly the underlying stroma. It is sharply circumscribed, consists of epithelioid cells and contains several types of giant cells. The stroma on the left shows small round cell infiltration.

Tuberculosis of the cervix is rare and such an early stage as is here depicted I have never seen before.

CAUDAL ANÆSTHESIA IN GENITO-URINARY SURGERY¹

By BRANSFORD LEWIS, B.S., M.D., F.A.C.S., AND LEO BARTLES, M.D., F.A.C.S., St. Louis

HISTORY

IN 1901 and 1903 Cathlin² proposed the use of normal saline injections into the sacral canal for the purpose of allaying certain nervous manifestations connected with the urinary tract, enuresis in boys and girls, tabetic crises, etc. Encouraged by some success in this endeavor, the same author later tried to induce anesthesia by injecting in a similar manner, but this proved unsuccessful with him and with other French experimenters of that period.

It was not until 1910 that material success was reported in this regard. Then Laewen³ described his use of one to two per cent solutions of novocaine in normal saline solution used in this way and the anæsthetic effect he secured therefrom.

Gros⁴ advised an alkaline base for the solution as promoting the intensity of anæsthetic effect and made use of novocaine bicarbonate together with a small addition of adrenalin.

Laewen made use of the sitting posture for the patient until the anæsthesia was well under way and began with 20 or 25 cc. While he mentioned that the anæsthetic effect was somewhat variable he claimed that very satisfactory results were obtained in many instances. Analgesia had been noted in the gluteal region, rectum and anus, skin of the scrotum and penis and of the upper and inner parts of the thigh, and in women the vulva and vagina. Laewen thought that probably the prostate also would be found to be analgeth through the same agency though up to the time of his report he had had no opportunity of confirming this belief.

In reviewing the subject of nerve blocking for local anæsthesia Harris⁵ mentioned the sacral method and reported having used it with good effects. This was our first introduction to the method. While we then had

little to go on, the method seemed logical, and we had had experience with Cathlin saline injections in certain cases with varying success but no bad effects.

To date we have essayed caudal anæsthesia in some eighty-five cases with results so favorable that we feel justified in making the report herewith presented.

ANATOMY

Thirty-one pairs of nerves branch off from the spinal cord, emerge through the foramina, and are distributed to the several parts of the body which they innervate. They are divided into five groups: the cervical, dorsal, lumbar, sacral, and coccygeal.

Sacrum. Although originally composed of separate segments the sacrum in adult life is blended into one bone. For present consideration its most interesting features are its *central canal* and its *foramina* (Fig. 1). The canal is a continuation downward of the spinal canal but at the second sacral segment communication between these two parts is cut off by the closure of the dura mater around the nerve branches (Figs. 2 and 3). This is not only demonstrable anatomically but Laewen³ found that colored fluids injected into the sacral canal never appeared in the spinal canal or colored the upper part of the cord showing the complete isolation of these two parts of the canal from one another by

¹Laewen and Gross: *D. von. Zeitschr. f. Chir.* 1911, p. 300.



Fig. 1. Sacra and varying forms of sacral hiatus. (P. Bull.)

¹Cathlin: *Les injections épidurales*. Paris, 1903, p. 89.

²Laewen: *Zeitschr. f. Chir.* 1910, No. 30.

³Gros: *Arch. f. exper. Path. u. Pharm.* p. 308.

⁴Harris: *Surg. Gynec. & Obst.* 1911, 11, 103.

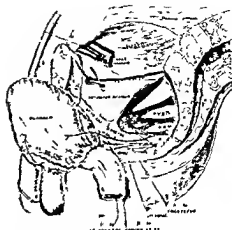
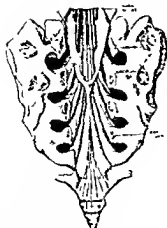


Fig. 2 (at left). Sagittal section of spine, showing spinal and sacral canals (Cunningham)

Fig. 3 Showing separation of spinal and sacral canals by closure of dura mater. Sacral nerves exposed (Gray Spitzka)

Fig. 4 Sacral plexus of nerves and distribution (Gray Spitzka)

closure of the dura mater. So that although the nerves are transmitted from the spinal canal down into the sacral canal there is no other communication between the two. This fact marks the distinction between this method of securing anæsthesia and that termed spinal anæsthesia in which the fluid is injected directly into the spinal canal. It likewise indicates that the two methods should not be confused with one another.

The nerve branches that descend thus from the spinal into the sacral canal are called the sacral nerves. From the sacral canal they pass through the sacral foramina out into the pelvis forming then the *sacral plexus* (Fig. 4), one of the most important of whose branches is the pudic distributed to the genito-urinary organs.

The sacral canal is enclosed in bony walls except at its lower end, here through non-development of the spinous processes the posterior bony wall is lacking and is replaced by a ligamentous membrane or covering. This opening is called the *sacral hiatus*.

It is through this hiatus that the hypodermic needle is directed for delivery of the fluid for anæsthesia. The opening is variable in size in different individuals (Fig. 1), but is practically always large enough to permit the introduction of a needle.

The sacral canal is flattened from before backward, and its caliber grows smaller as it curves downward toward the coccyx (Fig. 2). In the male the curve of the sacrum is fairly evenly distributed over the whole length of the bone, but in the female the upper part or base of the sacrum is projected more sharply backward for the increase of pelvic capacity pertaining to that sex. These variations have an influence on the ease or difficulty of introducing the long hollow needle through which the injection is made. The axis of the canal must be threaded by compensating movements while advancing the needle.

Distribution of nerves from the sacral plexus. The chief divisions of the sacral plexus are the sciatic and pudic nerves. The pudic terminates in three branches, namely, (1) the dorsal nerve of the penis, (2) the perineal nerve, and (3) the hæmorrhoidal. These supply the skin and the structures of the penis, scrotum, perineum, prostate and bladder, and the inner surface of the thighs posteriorly. A structure *exclusively* supplied by a certain nerve may be anæsthetized by deadening that nerve, but when the structure is supplied by another nerve also the deadening of one nerve only does not suffice for anæsthesia, the collateral nerve holds the tissues in a sensitive condi-



Fig 5 Landmarks for caudal anesthesia

tion This accounts for the fact that the lower extremities are not made analgesic by anesthetizing the sciatic nerve. Collateral innervation maintains sensibility.

PREPARATION OF SOLUTION

Various drugs have been added to the novocaine solution to make its effect more efficient and enduring but our experience has led us to believe that the two most useful adjuvants in this respect are potassium sulphate and adrenalin. The addition of these drugs permits the use of novocaine in much weaker solution while still retaining its effectiveness.

Chloretone although a local anesthetic and antiseptic, has been discontinued by us because of its irritating effects and also because analgesia has seemed just as good without it. The following solutions are freshly prepared before using:

A. One per cent solution of novocaine

B. One per cent solution of potassium sulphate

When ready for use these two solutions are combined in a sterile glass and two drops of adrenalin solution (1:1000) are added for each 30 cc. of the combined solution. Freshly distilled sterile water should be used for making the solutions.

Dosage. From forty to ninety cubic centimeters of the combined solution is injected, according to each individual case, the more



Fig 6 Finger covering the hiatus

sensitive individuals and the major operative procedures requiring the larger amount.

Prostatectomies demand larger quantities and more complete anesthesia. If one injection does not produce sufficient anesthesia an additional amount may be used.

Tests for insensibility. It is not advisable to apply tests before fifteen minutes following the giving of the injection. They are liable to lessen the confidence of a nervous patient in the success of the method. At twenty minutes the effect should be manifest or at its best. In prostatectomies or vesical operations, a part of this time is occupied in making the prevesical incision under ordinary infiltration anesthesia (Fig 9). When the operator arrives at the bladder wall he finds it insensitive and ready for incision. Previous to this, if desired, a test may be made by sounding the prostatic urethra and bladder, both of which should be influenced by the caudal anesthesia.

SUCCESS AND FAILURE

Just as with the use of drugs for any purpose and by any method so there is a certain variability in the effectiveness of this method for producing anesthesia. Aside from individual susceptibility there may be other reasons explanatory of this. The capacity of the sacral canal may be large or small, requiring a greater or lesser amount of fluid to fill it and exercise the pressure effect on the nerves that is so essential.

We have found it serviceable to use a

larger quantity of the more dilute solution than was formerly employed. Eighty or ninety ccm of the one half per cent solutions seems preferable to half that quantity of one per cent solutions.

Laewen reported 15 per cent failure in forty seven cases using 20 to 30 ccm of 1 to 2 per cent solutions. Our earlier experience gave about the same percentage of success (85), which seems likely to be improved under further study and use of the method. Its newness to us together with the paucity of literature regarding it, led us to feel our way in increasing the quantity of fluid injected rather than striving too ardently for uniform success.

But latterly we have used eighty or ninety ccm of anæsthetic fluid in a number of cases, without observing that it induced any more disturbance than the lesser quantities had given. The hypodermic administration of morphine or pantopon, given shortly before hand, contributes to the effectiveness of the result.

Harris says that so far the nerve blocking methods have been accompanied by no mortality. With two possible sources of danger eliminated, the sacral method of nerve blocking would seem capable of maintaining that enviable reputation. These possible dangers are injection of the fluid into a vein (Fig 8) and injection into the spinal canal. They are obviated by definite maneuvers related in the description of technique.

It is difficult to anticipate any other cause for anxiety in this respect.

The difficult cases for caudal anæsthesia are the obese, the very nervous, the hysterical, and children. Laewen has advised against its use in the aged, but we have found that these are the very cases in which it is especially advantageous. It has made operation possible in a number of cases debilitated and decrepit from advanced age and the ravages of urinary obstruction and sepsis, its freedom from shock and other depressing influences making it particularly desirable for this class of cases.

TECHNIQUE OF ADMINISTRATION

The patient is placed on his right side, with



Fig 7 Needle inserted into sacral hiatus

his head slightly elevated, and is instructed to bow his back strongly, bringing his knees and chin as near together as possible.

The area over the sacrum and the immediate neighborhood is cleaned with benzine, dried, and painted with iodine.

The sacral hiatus is sought for and is found just below the spinous process and above the coccyx (Figs 5 and 6). The rudimentary sacral spinous processes lead down to it.

Having infiltrated the skin and deeper soft tissues over the hiatus with the same anæsthetic fluid as is to be used for the sacral canal, a little massage serving to diffuse the solution to better advantage, the long needle fitted with a trocar wire is inserted into the sacral hiatus (Fig 7) passing through the membrane that covers the hiatus. The needle in being introduced is at first held at an angle of 45 degrees with the skin surface, but as soon as the operator feels the penetration of the membrane by the needle, the syringe is depressed almost to a level with the body plane at that point.

The needle is made to follow the axis of the canal, which it penetrates for a distance of 1.5 or 2 inches. When placed the trocar wire is withdrawn, and opportunity is given for avoiding the two dangers previously alluded to. If the needle has gone up too far and passed through the guarding dura mater into the spinal canal evidence will be given in the escape of numerous drops of spinal fluid through the needle. In this case

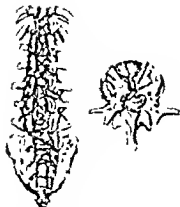


Fig. 8. Venous plexus of spinal canal in P. Bulli.



Fig. 9. Infiltration of supraperitoneal space.

the needle must be withdrawn until its point rests in the sacral canal and no more spinal fluid flows. If there is bleeding indicating that a vein has been punctured, the position of the needle is changed so that an inadvertent intravenous injection be not given. In case there is no bleeding it is well to make assurance doubly sure before injecting the anesthetic fluid. To that end a few drops of normal saline solution are first injected and permitted to return through the needle, thus removing a possible clot or shred in the needle. Blood will assuredly flow at this point if a vein be the resting place of the needle.

If not, and all things seem satisfactory, the injection is proceeded with 20 cc. at a time

being sent slowly and steadily through the needle by the Record syringe, repeated until the desired quantity is reached.

Some patients indicate the blocking effect on the nerves by complaining of pains or peculiar sensations down the thighs and legs. It has seemed to us that anesthesia portended better when such complaints were made.

Occasionally it is found that a curved needle is more favorable for threading the canal than a straight one conforming to a more sharply curved canal or a smaller hiatus

UNDESIRABLE EFFECTS

On one occasion before the technique described was adopted, the beginning of the injection was marked by emphatic complaints by the patient of severe pain in the head and chest weakness with undue frequency and irregularity of the pulse. It was recognized at once that the injection was intravenous and it was promptly discontinued. The symptoms passed off shortly afterward and there was no objectionable after effect.

At other times we have noted transient indications of weakness, moisture of the skin, frequent pulse, etc., but whether these were due to the effects of the injection or to nervousness and apprehension on the part of the patient it has been difficult to say. We have had patients that fainted incidental to a



Fig. 10. Prostate and vesical stone removed under caudal and infiltration anesthesia.

rectal palpation of the prostate, from the strangeness of the situation and nervousness of the patient. So that it is not always easy to differentiate between nervousness and toxicity. However, the effects have never proved serious in any case as yet.

If less than a toxic amount of novocaine be used, and it is used under the plans and precautions described, we can see no reason why it should prove dangerous or show a mortality.

TOXICITY

In referring to the toxicity of novocaine, Braun¹ says that while he had never noticed any disturbance following the subcutaneous injection of 2 per cent solutions, Laewen had observed typical poisoning symptoms following the injection of 25 ccm of 2 per cent solution into the sacral canal. The symptoms consisted of nausea, sweating, anemia, rapid pulse, frequent respiration, feeling of oppression, and haze in front of the eyes. The authors had noted that these symptoms could be avoided by making the injection slowly. In experimenting on the nerve-trunks of the lower extremities, Laewen had used as much as 21 grains of novocaine without toxic effect. In one case the patient had received 20 ccm of 4 per cent solution, in another 30 ccm of 2 per cent solution. He has injected 50 ccm of 1 per cent solution and larger quantities of 0.5 solution. In only a few of the cases were toxic symptoms noticed. Finally (*ibid*, p. 180) Braun remarks that, "since Laewen has shown that the 4 per cent novocaine-suprarenin solution is harmless, even in large quantities, the author has been using this solution." And he further remarks, "The toxic action of this drug is less than that from any hitherto known anæsthetic substance."

ADVANTAGES OF SACRAL ANÆSTHESIA

The pre eminent advantages of this method do not appear in ordinary routine surgical cases. These can be anæsthetized with ether or gas-oxygen with little risk, if administered by an expert. But when an aged individual, so reduced by pain and toxæmia,

and by back-pressure in his urinary tract that he is utterly miserable and decrepit; so debilitated that he has no resisting powers to stand further depletion; and seems both ripe and ready for dissolution; and so old that there is no promise of restoration from this source; then we have the patient for whom this mode of anæsthesia is appropriate and most advantageous. It is a question then of safety first, of life and death, not simply a choice between several equally safe methods of anæsthesia.

Anæsthetized by this method, we have seen just such cases undergo various operative measures connected with the bladder and prostate, who both during and after such operations were serene and comfortable, free from cardiac, pulmonary, or gastric disturbances, and ready at once to take liquids and light nourishment.

ILLUSTRATIVE CASES

CASE 1. P. K.—y, age 63, laborer, poorly nourished, chronic rheumatic and inebriate, poor risk from every standpoint. Arteriosclerosis and myocardial degeneration present. Urinary tract septic, urine loaded with pus and bacteria, urination every five to forty minutes. Repeated septic chills and fever. Cystoscopy showed large intravesical prostatic hypertrophy, together with a stone almost as large as a hen's egg. After five days' preparatory treatment, the patient was operated on by the suprapubic route, under caudal and infiltration anæsthesia as described, the specimens shown in Fig. 10 being removed. The patient suffered none at all, either from pain or shock, and expressed himself as more comfortable after operation than before it. Recovery was uneventful and the patient was ready to leave the hospital in three weeks.

CASE 2. Wm. McG.—n, age 76 very feeble, ill nourished, emaciated, and cachectic. First essay at cystoscopy under ordinary methods of local anæsthesia was a complete failure, the patient squirming and resisting to a degree that prevented even the introduction of the instrument into the bladder. With this experience in mind, and with memories of previous attempts at instrumentation by other surgeons, the patient very impressively informed us that he would submit to operation or anything we wished to do, *only on condition that it was done under ether anæsthesia*. In this stand he was backed up by his family. His enfeebled condition made it highly desirable that he be operated on without the addition of any factors of shock or disturbance. Bronchitis present forbade the use of ether.

A little diplomacy paved the way to the use of

caudal anesthesia for a second attempt at cystoscopy, five days after the first one. The effect was all that could be desired. The patient was comfortable throughout, relaxation permitted the introduction and complete manipulation of the cystoscope, and from this very satisfactory examination there was confirmation of a previous suspicion of prostatic carcinoma. This diagnosis explained the hyperesthetic condition prevailing locally, as well as the unpromising condition generally. Nevertheless, it was still considered advisable to operate to relieve the obstruction and sepsis present.

The caudal anesthesia had been so eminently pleasing to the patient that he made no further objection to its use in the subsequent major operation, and it was applied with equally as much satisfaction. After suprapubic opening of the bladder, the larger proportion of the growth, hard, dense and resistant, was removed by digging tearing and morcellation leaving at least a good channel for the escape of urine, it not preventing the future return of the growth. The latter had involved adjacent structures to a degree that made radical removal out of the question.

But the caudal anesthesia was both effective and innocuous the patient was in as good condition after the operation as before, and his progress since then has shown that neither operation nor anesthesia added to his disability or distress and it is expected that the remaining tenure of life may at least be more comfortable.

Other simpler cases might be related in which everything has gone more evenly than in these but it must be remembered that it

is solving the difficult and unpromising cases that makes the method attractive or worthy.

Total number of cases .. .	85
Divided as follows	
Prostatectomies	13
Cystoscopies	68
Cystotomies	2
External perineal urethrotomy	1
Rectal carcinoma	1

RESULTS

Ten of the 13 prostatectomies needed no other anesthesia, 2 required a small amount of ether.

One required complete ether anesthesia, there being no effect from caudal injection.

Of the 68 cystoscopies forty-six gave excellent analgesia.

Thirteen gave partial analgesia.

Five gave no analgesia, 3 of these 5 failures we believe due to faulty technique.

One of the cystotomies (for calculus) gave good analgesia and the prostate could have been enucleated.

One required a small amount of ether, as curettement of a carcinomatous mass was done.

The one case of external urethrotomy (perineal) gave complete analgesia.

The one rectal case (carcinoma) was a failure.

RESULTS OF OPERATIONS FOR EXOPHTHALMIC GOITER¹

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IN this review of cases of exophthalmic goiter, we have endeavored to ascertain as nearly as possible the results of operation for the condition. As is well known, it is difficult to determine when a condition of this kind is cured, and that some of the patients who are apparently cured may ultimately have relapses. In order that a sufficient length of time should have passed since operation, only the patients operated on in 1909 and in whom a definite diagnosis had been made were selected for this study.

The diagnosis of exophthalmic goiter in these cases was based on the clinical history and the histologic changes in the tissues when a part of the thyroid was removed. In a certain number no tissue was removed, ligation of the thyroid vessels only being done. In most instances, however, the thyroid was resected. The cases were all in the hyperplastic toxic group as described by Plummer and Wilson. (There was a definite so-called hypertrophy in all of the thyroids removed which was diagnosed by the clinician as exophthalmic goiter and by the pathologist as hyperplastic thyroid.)

Of the 176 patients in the series operated on in 1909 we have been able to trace 121 by correspondence and subsequent examinations. A number of these have returned several times for examination and many of them have reported by letter several times.

It has been our custom to ligate the superior thyroid vessels in two types of exophthalmic goiter cases. In one type the disease was mild and we hoped the procedure might be sufficient to effect a cure. In the other type the disease was severe, and one or more ligations were done as a preliminary to resection. These patients were advised to return in three months for the removal of a part of the gland, but some of them were so greatly improved by the ligations that they did not return.

Of the 121 patients that were traced, 56 were ligated; 36 had primary resections of the thyroid; 20 had preliminary ligations followed later by resections. Nine of these patients were operated on for recurrence at which time either one of the vessels was ligated or a part of the remaining piece of the thyroid was resected. The patients have been classified in five groups.

Group I. In this group there were 55 (45.4 per cent) patients cured; i.e., those who had been well for some time and as far as they knew, or as we could judge, were completely relieved of all their former symptoms. In 16 of the 55, primary resections had been done, in 11 resections following ligations, in 24 ligations alone, and in 4 secondary ligations or resections following resections. We believe that the preliminary ligations should nearly always be followed by thyroidectomy, and that when ligations alone are done, late recurrences are much more common. On a number of occasions we have done thyroidectomies for the recurrence of symptoms after patients had been well for more than five years following ligation. One patient in this group was well for more than five years after the ligation of both superior thyroid vessels, then all the symptoms of hyperthyroidism gradually returned and the gland was resected. The following histories are illustrative of the cases in this group.

CASE 1. Mrs. A. M. B., (A30,233), aged 27 years. Examination October 18, 1909. Acute symptoms of hyperthyroidism began about five and one half years before. Enlargement of the thyroid was first noticed five years before. Six months before the appearance of the goiter she began to lose weight, was restless, irritable and had slight tremor and general nervousness. Pulse 60. Two weeks after the goiter appeared, there was a rather sudden onset of tachycardia with diarrhea. Pulse 170. There had been nausea and vomiting and edema of the feet for six weeks. All the symptoms, except gastro-intestinal, had continued for two years.

She was exhausted, unable to work, and lost 20 pounds during this time. During the last three years there had been gradual improvement. At the time of examination the pulse was 130, there was dyspnea, exhaustion on exertion, and restlessness. There was very little change in the size of the goiter, if anything it was a little smaller. She had some difficulty in swallowing. Electrical treatments had been given. The thyroid was firm, the right lobe larger than the left. The heart was regular and not enlarged. Her strength was fair, and nutrition good. The exophthalmos which had existed for five years was quite marked, uneven, more noticeable on the right side.

On October 20, 1909, the right lobe and isthmus were extirpated. The pathologist reported hyperplastic thyroid. The patient had a normal convalescence and left the hospital in a few days. She was the wife of a physician and we were thus able to follow her condition accurately. One year after the operation only a slight trace of trouble remained. Four years later her husband reported that she was entirely well though the right eye was still a little more prominent than the left. At the present time, she is entirely recovered and there is no evidence of her old trouble. A letter from the patient states that it was about two years after the operation before she considered herself well. She now works with perfect ease. Her pulse is about 80. She has gained about ten pounds in weight. Her voice is clear. She is in fact in splendid health.

CASE 2. Dr. N. B., (A29,110), male aged 27 years. I examined September 17, 1900. The goiter was first noticed two years before. Hyperthyroidism probably started at about the same time. A small nodule in the right lobe of the thyroid was first noted, since which time there has been tachycardia and some loss in weight and strength. From that time palpitation, tachycardia and loss of weight has been variable. He had spells of diarrhea for two or three days at a time, sweating profusely. He first noticed exophthalmos about six months before. Tremor was not noted until a few months before, since which time the symptoms gradually became more severe. The thyroid was rather soft and the right lobe somewhat larger than the left. There was slight enlargement throughout the gland. The heart was normal in size. The pulse was 120, soft and slightly irregular. The white blood count was 6,320, total lymphocytes 49 per cent. Operation September 20, 1900. Extirpation of the right lobe and isthmus. Pathologic report hyperplastic thyroid.

One year after the operation this patient reported that he was much improved though there was still slight evidence of the old trouble. Six months after the operation he had had a relapse of the tachycardia, but this cleared up in a few months. He can now do as much work as he could before the beginning of his trouble. The exophthalmos has entirely disappeared. Present average pulse rate 85. Normal weight before his trouble began was 150

pounds, present weight is 165 pounds. His voice was not affected by the condition.

CASE 3. F. E. K., (A20,797), male aged 40 years. Examination March 2, 1909. The goiter was noticed nine months before, though there may have been some evidence of hyperthyroidism for two years. He had acute illness two years before which was called by grippé. He had been a little nervous for years and thought that his present trouble has been coming on gradually for several years. He had lost 30 pounds in weight and complained of weakness, nervousness, and dyspnea on exertion. There had been no vomiting or diarrhea. Examination showed a hard gland, generally enlarged. No dilatation of the heart and no evidence of myocarditis. Pulse 120 to 130. Exophthalmos regular and quite marked. The first operation was done March 6, 1909, when the right lobe and isthmus were extirpated. After this he felt fairly well when resting. He grew stronger, less nervous, and gained 10 pounds in weight immediately after the operation, but lost it after working two weeks. When he returned for examination October 22, 1909, his pulse was 120. During August and September he had about ten attacks of biliary colic, with diaphragmatic spasms, and was obliged to take morphine several times on account of pain. October 29, 1909, the left lobe was resected. The pathologic report on both pieces of tissue was hyperplastic thyroid.

This man reports that about 8 months elapsed after his second operation before he considered himself entirely well, but he is as well as before he began to have the trouble. He can now do his work with ease. The prominence of his eyes has disappeared. He regained the 10 pounds in weight and now weighs 150 pounds. This patient has recently undergone a successful operation for gall stones.

CASE 4. A. M., (A26,401), female aged 16 years. Examination July 17, 1909. Goiter first noticed one and one half years before. She had been nervous for several years and had noticed tremor. There had been a gradual onset of symptoms of hyperthyroidism, tachycardia, dyspnea, palpitation, loss in weight, etc. Ten months before the symptoms had been severe and for several weeks she had been unable to be on her feet for any length of time. She had spells of diarrhea lasting three or four days at a time and several spells of nausea and vomiting. Exophthalmos for eleven months. The thyroid was enlarged, thrills distinct, the left lobe larger than the right. The heart was dilated $1\frac{3}{4}$ inches to the left. There was a systolic murmur at the apex. The pulse rate was 150 and full. The white blood count was 8,000, total lymphocytes 42 per cent. Operation July 29, 1909. Ligation of both superior thyroid arteries.

This patient writes that she is much stronger than at any time before she had the trouble. There has been no recurrence of symptoms and she can do more work than before. The prominence of her eyes has gradually diminished. The appearance of her neck is normal. Pulse 80, hands steady. She

has not taken medicine since her operation. She thinks that about six months elapsed before she was entirely well.

CASE 5 Mrs A O M, (A27,574), aged 34 years. Examination August 7, 1909. This patient had a goiter at the age of 18 which disappeared. Her mother had one at 20 and it disappeared. The second goiter was first noticed about a year ago. Symptoms of hyperthyroidism, tachycardia, nervousness, and enlargement of the thyroid, had persisted for about five months. There was an irregular nodular enlargement of the gland. The heart was not dilated, pulse 120 to 120. There was some prominence of the eyes. The white blood count was 9,200, total lymphocytes 47 per cent. Operation August 18, 1909, ligation of the superior thyroid vessels. For more than two years after this, during which time she gave birth to a child, she felt well. In January, 1911, she returned, stating that for two months she had been having palpitation, dyspnea, and nervousness, though not nearly as severe as before the ligation. She had lost 17 pounds in these two months. On January 10, 1911, the right lobe and isthmus were removed. Pathologic report: hyperplastic thyroid.

She now reports that she is well. She thinks it was about six months after the second operation before she was entirely well. She had a few slight temporary attacks of palpitation and nervousness. The prominence of her eyes has diminished. The pulse was 68. Normal weight before her first symptoms was 120, just previous to the thyroidectomy 98, present weight 124. She had no trouble with her voice. Her husband, who is a physician, writes that in his opinion she is as well now as before the beginning of her illness.

Group II In this group of 22 patients (18 1 per cent) all were practically cured of their symptoms but still at times had slight evidence of the disease. Many of these are entirely well, though occasionally under sudden nervous strain they show that they are not entirely normal. In this group there were eleven primary resections, four resections following ligations, six ligations and one secondary resection. Some of the case histories are given as typical of results in the group.

CASE 6 Mrs A A, (A27,925), aged 28 years. Examination August 19, 1909. The goiter was first noticed two years before, the hyperthyroidism probably started five months before when the goiter rapidly increased in size. There was a sudden onset of typical hyperthyroidism, profuse sweating, rapid loss in weight, etc. Examination showed the thyroid generally enlarged, bruit and thrill marked over arteries. Pulse 160. Exophthalmos marked. Long, harsh systolic murmur. On May 24, 1909, both superior thyroid arteries were ligated.

One year after the operation the patient wrote that she was apparently entirely well. She now writes that she is not quite so well; is nervous at times, but does not think there is any evidence of her old illness. Her general strength is improved, but she tires more easily than before she had the trouble. A slight enlargement in the region of the thyroid can be felt. Pulse 85, weight about normal. No tremor.

CASE 7 Mrs J M, (A30,012), aged 54 years. Examination October 17, 1909. This patient noticed the goiter four months before. Hyperthyroidism had probably lasted about eight months. She was weak and unable to do her housework. She lost about 50 pounds in weight. Tremor gradually became worse, now affecting her entire body. She was nervous and irritable and perspired easily. The thyroid was found generally enlarged, the right lobe larger than the left. It was firm, rounded, and regular in outline. The heart was slightly enlarged, the heart sounds slightly deficient, regular at apex. There was a systolic murmur. The pulse was 120, regular, and of good quality. The white blood count was 9,000, total lymphocytes 35 per cent. Operation October 19, 1909. thyroidectomy, extirpation of the right lobe and isthmus. Pathologic report: hyperplastic thyroid.

This patient writes that all of three years elapsed before she considered herself well, and at present the condition of her nerves is not good. However, there has been no recurrence and no evidence of the old trouble. Her strength has improved, she is able to do her housework. No exophthalmos. No tremor. Weight before the appearance of symptoms was 180, previous to the operation 120, at present, 200 pounds. Her voice has not been affected.

CASE 8 D B, (A26,468), woman, aged 43 years. School teacher. Examination July 19, 1909. The goiter was first noticed four months before at which time symptoms of hyperthyroidism developed: palpitation, tachycardia, dyspnea, sweating. She complained of being hot, gradually developed tremor and diarrhea. There was no vomiting. The symptoms were progressive until May or the first of June, when they reached their height. For some six weeks she could hardly get about. She was treated by rest and gradually grew better. Exophthalmos was present. The thyroid was hard with areas that felt cystic. The right lobe was considerably larger than the rest of the gland. The heart was dilated one half inch to the left. There was a mitral systolic murmur. The pulse was 140, but with good tension. The white blood count was 10,000, total lymphocytes 30 per cent. On July 30, 1909, both superior thyroid arteries were ligated. This patient returned in May, 1911, stating that after the ligations she was in bed most of the time for three months because of palpitation and irregular heart action, since then she has been weak and unable to do much work. Palpitation occurs on excitement or exercise. Pulse from 80 to 90. Prominence of the eyes less. Operation

May 15, 1911 thyroidectomy, extirpation of the right lobe and isthmus

This patient reports that her nerves are not so strong as they were before her illness. She is troubled more or less with sleeplessness, but her general health has improved and she can work with more ease. The prominence of her eyes has disappeared, there is no enlargement of the neck. Average pulse 80. No tremor. Normal weight 100, previous to operation 75, present weight 100. She cannot use her voice as well as she could.

Group III. In this group of 7 patients were those who reported that they were markedly improved, but most of the time there was some evidence of the old trouble and those who retained a little exophthalmos or nervousness. Most of them had entirely regained their normal weight and physical strength. Of the 7, 3 had been simply ligated. In all probability if these 3 patients and the 6 in Group II who had simply been ligated would have resections now the few remaining evidences of the disease might entirely disappear. One of the patients in Group III had a primary resection, 1 had a resection following ligation, and 2 had secondary resections. Typical case histories are as follows:

CASE 9 N. M., (A28,982), female, aged 22 years. Examination September 14, 1909. There had been gradual onset of nervousness, tachycardia, dyspnoea, sweating etc. several years before and the patient had stayed in bed the greater part of a year. She then improved until within the last three months when she became gradually worse. There was a firm prominence of the right and left lobes of the thyroid. Marked bruit of the upper poles. Heart regular not dilated. Pulse 130. Marked systolic murmur at the apex. Exophthalmos quite marked. White blood count 6000 total lymphocytes 33 per cent. Operation September 22, 1909 ligation of both superior thyroid arteries.

Recent report states that she has never considered herself entirely well though her strength has gradually improved. Pulse 92. There is some tremor, shortness of breath. Normal weight before her first symptoms 114 pounds, present weight 112. She has had an attack of jaundice with rheumatism and gastric disturbance, since her operation.

Group IV. In this group we have placed 5 patients in whom there was slight improvement. In one a simple ligation had been done and this patient might now receive considerable benefit from a resection. As a rule, marked benefit follows ligation, if not cure should not be expected in case the patient

should have a thyroidectomy. Of these 5 patients, 3 had primary resections, and 1 was operated on a second time with little or no improvement. The following cases represent this group.

CASE 10 Mrs. A. G., (A23,024), aged 43 years. Examination April 30, 1909. Hyperthyroidism had existed for five years. She visited our clinic in 1904, when the diagnosis of Graves' disease was made. She was weak at that time and did not stay for treatment. She improved following this attack and her condition continued to be nearly normal for about a year. One year prior to her second examination she began to lose weight rapidly (15 pounds). After three or four months she again improved and was fairly well until April of the following year when she had a spell almost as serious as the first one. Exophthalmos at that time was quite marked. There was considerable enlargement of the right lobe of the thyroid, and slight enlargement on the left side. The heart was irregular in rhythm and force and was dilated one and one fourth inches to the left. The pulse was regular, 114. The white blood count 5700, total lymphocytes 36.6 per cent. August 5, 1909, double ligation of the superior thyroid vessels was done. August 16, 1909, the right lobe was extirpated.

This patient writes that she is not as well as she was before her original attack, her strength has improved but her general health is not good. Pulse 80. No tremor.

Group V. The 8 patients in this group derived little or no benefit from the operation. One had a primary resection, 1 a secondary resection, and 6 were simply ligated. The following history is representative of this group.

CASE 11 Lemah (A27,442) aged 19 years. Examination August 1, 1909. This patient had noted nervousness not marked for about three years. For the past nine months she had been easily exhausted. There were increased dyspnoea, nervousness, and difficulty in getting up stairs. She had two or three spells of vomiting, was frequently nauseated, her feet were swollen. The thyroid was found moderately hard and nodular. There were thrills over the superior thyroids. The heart was slightly dilated. The pulse was 144 and there was some exophthalmos. The white blood count was 6200, total lymphocytes 34.9 per cent. Operation August 5, 1909 ligation of the superior thyroid vessels. May 9, 1910 thyroidectomy, extirpation of the right lobe and isthmus.

This patient has not been as well as she was before the beginning of her illness. Her general health improved for a time but there has been a recurrence of the former symptoms. The eye prominence diminished for a time and again returned. Pulse 118 and irregular. There was tremor and some hoarseness.

In addition to the 121 patients, 3 others were traced but sufficient data to classify them were not obtained. Patients who are benefited, but not cured, by the removal of a part of the thyroid will in many instances improve greatly with a resection of the remaining part of the gland. This point has been demonstrated in 9 of our patients in whom the symptoms recurred and the second operation was done. Of these 9 patients, 4 were cured by the secondary resection; 1 was practically cured, though slight evidence of the disease remained, 2 were greatly improved. These results tend to bear out the impression that if the patients are not cured it is because enough of the gland has not been removed.

An effort has been made to determine the factors pertaining to exophthalmic goiter which would indicate the results from operative treatment that might be promised patients. In this, however, we have been only partially successful. In 8 of a group of 13 unsuccessful cases there was considerable dilatation of the heart at the time of operation, and several of the patients had developed edema. A complete cure could not be expected in this type of case, nevertheless, in several instances great benefit was derived from the operation. Twenty-five of the 55 patients who were cured had some dilatation of the heart at the time of operation.

The oldest patient operated on (57 years of age) and the youngest (4 years and 2 months) were cured. The average age of the patients cured was 30.7 years, the average age of patients deriving little or no benefit was 29.1 years.

In the series of 121 patients traced, there were 107 females and 14 males. All but 2 of the males were benefited. The average length of time in which these patients had had symptoms before coming for treatment was about the same in the group of cured (19.3 months) as in the group receiving no benefit (22.2 months). The average length of time required to effect a cure was 17.9 months. In the second and third groups, in which were included the patients who were better but not cured, the average length of symptoms was longer. In Group II, 31.6 months,

in Group III, 49.2 months. Despite the fact that the statistics do not emphasize this point, we believe that more cures and better results will be obtained in patients having symptoms for short periods than in those having symptoms for a number of years. The average duration of symptoms in patients who were cured was 19.3 months. It would seem reasonable to assume that if patients could have been treated within the first year a larger percentage would have been cured.

All of these patients had some degree of exophthalmos (Stellwag or von Graefe) before operation, many of them complained of pain and tension of the eyes which usually disappeared soon after operation. Often they stated that their eyes felt much better even before there was any appreciable change in the degree of prominence. From our observations it would seem that the exophthalmos is one of the last symptoms to subside, sometimes it persists long after all other evidence of the disease has cleared up. Seventy-five patients reported that all prominence of the eyes had disappeared or was greatly diminished.

The functional results in our cases have been very satisfactory. A low collar incision just above the clavicle reflecting the superficial tissue flaps, severing the muscles just below their upper attachment on either side, if necessary is inconspicuous. This incision heals quickly and normal motion of the head and neck returns in a few weeks. In a small number of patients there has been some disturbance in the voice, though this has been temporary. It is apt to be most marked about the fourth or fifth day when the edema is greatest. In one instance there was total loss of the voice for two months, when it rapidly returned to normal. The characteristic squeaky goiter voice so often heard in exophthalmic patients before operation usually completely changes to normal by the time the wound has healed. Some of our patients who speak with the normal motion of the vocal cords have complained of the voice being weak or tiring easily. At times it is husky, and there is difficulty in singing. All of these symptoms usually subside in a very short time.

Of the 176 patients operated on in 1909 (some had three operations), 21 died, 7 in the hospital. All of these were females; the oldest 46 years, the youngest 15. In 5 a single ligation only was done; in 2 there were resections. The average length of time symptoms had existed prior to operation was 29.5 months. One of the patients who died following resection had had a ligation and seemed entirely well. About five years after the ligations in our clinic, she had a hysterectomy performed elsewhere. Her goiter symptoms recurred, growing gradually worse, and she returned to us for resection.

The histories of the patients who died show that they were all operated on at the time of the maximum severity of the disease. If we had realized then as we do now the danger of operative interference at the height of any attack of hyperthyroidism, the patients might have been carried past the period of maximum severity before operating. In all of these patients hyperthyroidism was the clinical diagnosis of the cause of death, 4 showed dilated hearts and edema. The average loss of weight of the 7 patients at the time of operation was 42 pounds. The average white blood count was 7,800, and the average lymphocyte count 49.3 per cent.

Fourteen patients have died since leaving the hospital, 1 ten months after a double ligation. This patient had a recurrence of the trouble, was operated on elsewhere and died. The average length of time between operation and death in these 14 patients was 14.1 months. In 11, ligations were done, in 2, resections, and in 1 there was a recurrence. The average age was 34.1 years. Eleven had dilated hearts, 4 systolic murmurs. There

was edema in 6 and evidence of nephritis in 4. From this review of the histories of patients who have died, it seems evident that the condition was extremely toxic. It is quite probable that most of them died because of continued intoxication which had produced irreparable damage, usually in the heart, liver, and kidneys.

Better judgment as to what should be done and when to do it has lowered the mortality considerably in the past five years. In the series of letters received from exophthalmic goiter patients during the past few months, eleven mention having borne healthy children since operation. One woman had had three children. In two pregnancies one patient had had a recurrence of all the symptoms of hyperthyroidism and, because of this, abortions had been performed. This patient's report did not make clear that she was really suffering from hyperthyroidism when pregnant. Her chief symptom was vomiting and this, of course, may have been the pernicious vomiting of pregnancy, however, she had had one normal pregnancy without serious vomiting, before her attack of hyperthyroidism. Eight of the women who have had children since operation have been classified in Group I, as cured, two of them in Group II, as improved, and one in Group III in which no benefit has been derived from operation.

Judging the results in this series of 121 patients, a cure may be expected in about 45 per cent. In addition to this, about 23 per cent will be practically cured, although a slight trace of the old trouble may persist. Our statistics show that an additional 4 per cent obtained some benefit. About 5 per cent reported that they had received no benefit.

PANCREATIC CYST AS A CAUSE OF UNILATERAL HÆMATURIA¹

WITH REPORT OF A CASE

By JOSEPH RANSOHOFF, M.D., F.R.C.S. (Eng.), F.A.C.S., CINCINNATI

THE report of a single case before a body, singly and collectively as experienced as the Southern Surgical Association, requires some justification. Thus, I believe I can claim for the following report, because of an error in diagnosis, largely attributed to a symptom hitherto undecribed in connection with an abdominal growth, which in itself is rare, for cystic tumors of the pancreas are surely not common.

So far as I can now recall, I have had an opportunity of operating on only six cases. From the enormous material of the Mayo Clinic for the last two years one must conclude that pancreatic cysts are rare. Of a little over 5,000 abdominal operations performed in 1914, only two were for pancreatic cyst. Among 4,764 sections in 1913, there were none for pancreatic cyst, although in that year six cases were so diagnosed.

In a very extensive review of the literature, I have found no other case in which, as the one to be presented, profuse hæmaturia was a cardinal symptom and led to an error in diagnosis.

W. L., aged 61, farmer, referred by Dr. Conard, of Blanchester, Ohio, to whom I am indebted for the history previous to the patient's admittance to the hospital. The father died at 70, of mastoid disease, mother at 60 of tuberculosis. One sister died of tuberculosis at 30 and one of pneumonia. One brother is living, age 50. The patient was always strong and well until three years ago. Habits excellent. The present illness began three years ago with violent abdominal pains in the region of the umbilicus. The pains lasted for five or six days, and disappeared after free catharsis. Their exact nature could not be determined. There was no elevation of temperature, no tenderness that could be particularly localized. During convalescence there was severe pain in the left arm and shoulder, which lasted for several days, but could not be explained.

A year ago the patient had a similar attack, from which he did not recover as promptly as from the first. He could not walk erect, there was tenderness on pressure in the left hypochondriac region and

in the region of the left kidney, but no tumor mass could be felt at the time.

In June, Dr. Briggs recognized a tumor in the left upper quadrant. The patient has not been well since, but did not prevent himself for examination again until September 6, when he came on account of passing large quantities of blood with the urine. At this time he stated that he had had for a number of years pain on the left side under the ribs, and this was at times followed by the passing of bloody urine. During the last year the patient has lost over 30 pounds. He has coughed a great deal, and a single examination of the sputum showed the presence of tubercle bacilli.

Condition on admission to the Jewish Hospital, September 14, 1915. Well developed male, weighing 90 pounds, but evidently much reduced from his normal weight. Facial expression that of prolonged suffering. Pulse about 90. Systolic blood pressure 110. Temperature normal, hæmoglobin, 90 per cent, red count, 4,200,000, white, 8,700, polymorphonuclears, 74, mononuclears, 3, large lymphocytes, 74, small lymphocytes, 15, eosinophiles, 14. Urine dark in color, almost chocolate, contains a large amount of blood intimately mixed with the urine. No clots. Negative for bacilli. Stools normal in color and consistency. Negative for occult blood.

Physical examination. Percussion negative. Auscultation reveals coarse, moist râles over the greater part of the left lung, which accounts for the profuse expectoration. The sputum repeatedly examined for tubercle bacilli was negative, although the report of Professor Wooley states that almost everything else, streptococci, and staphylococci, diplococci and sarcinae, were present. It is probable that the tubercle bacilli found on one previous examination before the patient's admission to the hospital came from the mouth or gums, which were in bad order, the latter being very much retracted. The X ray of the chest was negative.

Abdomen. In the upper left quadrant a tumor nearly as large as an adult head is palpable. Viewed from the foot of the bed the upper half of the abdomen showed the tumor projecting in a graceful curve, the highest point of which is fully two inches above the general level of the integument. The lower abdomen shows nothing abnormal. Percussion over the growth elicits a flat note, which extends over the axillary line, and continues to the spine, except for a tympanic band, descending from above and to the left of the median line, and evidently produced by the colon. There is a fullness in the left costal-lumbar space. The tumor is distinctly fluctuating. The X ray examination shows a normal shadow of

¹ Read before the Southern Surgical and Gynecological Association, Cincinnati, December 13-15, 1915.

the lower half of the right kidney. In the upper part of the abdomen there is a tumor shadow, which extends to the right of the median line and lifts the left half of the diaphragm. The colon filled with barium boric shows no deflection.

Cystoscopic examination. Bladder and ureteral orifices normal. From the left ureter there is a rhythmic expulsion of a bloody stream. On account of the exhausted condition of the patient ureteral catheterization was refrained from, and the injection of indigocarmine used. Within five minutes a nearly black stream was belched from the right ureter and one almost as dark from the left.

Clinical diagnosis. Cystic sarcoma of the left kidney without any question mark. Operation was performed September 17, 1915, under gas ether anesthesia. A left lumbar incision was made through costo iliac interval, with easy exposure of the left kidney. When this was brought into the wound no trace of the tumor was found, although the kidney looked somewhat larger than normal, and darker in color. An incision through the peritoneum to the inner side of the colon permitted the palpation of a large retroperitoneal growth, which could be best reached from in front. The kidney being anchored, the incision over it was closed with layer sutures. Median incision first disclosed the spleen, which projected below the lower border of the ribs and measured approximately eight inches in both surface diameters. Its surface was dark purple. The sharp anterior edge overlapped the cystic growth, which it was now evident projected between the transverse colon and the greater curvature of the stomach. The diagnosis of pancreatic cyst was of course easily made and after tapping and eversion of a portion of the cyst wall, the remainder was attached to the abdominal wall. The operation was completed in the usual way of draining cysts of the pancreas. There were over 1,000 ccm. of the fluid removed. This was rather viscid blood stained, and contained a large number of little yellowish masses globular in shape easily crushed and looking not unlike miniature butter balls. A few of these were adherent to the cyst walls. They consisted in fact of saponified fat.

The analysis of the fluid, made by Professor Reemelin showed positive evidence of (1) alkaline proteinose, (2) amylose, and (3) lipose. Evidently, therefore, the digestive ferments found were of pancreatic origin. The cyst wall according to the report of Professor Wooley contained no pancreatic tissue. It is composed of a typical granulation tissue of which there are very many polymorphous leucocytes, indicating that the cyst was of a chronic inflammatory character.

Subsequent history. The error in diagnosis evidently did not influence the post operative course. The wound over the kidney healed by first intention. From the third day on the urine became less and less bloody and after the end of the week had become clear and remained so to the end. The abdominal incision did not do so well but for a period

of three weeks gave us much concern on account of the irritation of the skin from the discharge, which is common after pancreatic drainage. Unfortunately, the pulmonary condition recognized before the operation was aggravated, and pneumonic patches developed first in the lower part of the right lung, and gradually extended upward. The profuseness of the expectoration suggested the possibility of a pulmonary abscess, although X ray examination and very careful physical examination made by Dr. Rachford demonstrated only a progressing bronchopneumonia. To this the patient succumbed nearly seven weeks after the operation. The abdominal wall was almost completely closed and drainage so slight as to require dressing only every three or four days.

So far as my knowledge goes from a rather extensive study of relevant literature the case presented is unique in that renal hæmaturia was caused by a pancreatic cyst. It doubtless was the result of pressure on the left renal vein. A like pressure on the splenic vein, caused the enlargement of the spleen to four or five times its natural size.

It is clear to me now that an error in diagnosis might have been avoided by two methods of examination which were not practiced, because in my judgment there was a limit to the amount of investigation which the exhausted patient would tolerate.

Had we resorted to an X-ray plate of the stomach and colon simultaneously filled with barium the relation of the tumor to the stomach and colon would certainly have been demonstrated. Again an injection of collargol into the pelvis of the kidney would likewise in all probability have shown a normal renal pelvis which does not go with tumors of the kidney, since it is quite certain that almost every growth of the kidney associated with hæmaturia can be recognized by the deformity which the collargol distended pelvis reveals upon the radiogram.

Furthermore the hæmaturia in the total absence of clots looked clinically more like that which attends an inflammatory condition than that associated with tumor of the kidney. It would have been better perhaps to drain the cyst from the wound in the loin as has been done by Pierce Gould, and Johnston but by the time the nature of the growth was made certain by the abdominal incision the posterior one had been definitely closed.

SALPINGITIS SECONDARY TO APPENDICITIS¹

By JAMES E. MOORE, M.D., F.A.C.S., MINNEAPOLIS, MINNESOTA

THE writer's experience goes back to the time when we had perityphlitis, pelvic hæmatocele, and pelvic cellulitis. We first learned that perityphlitis was due to an infection in the appendix. We next learned that what was termed pelvic cellulitis was due to an infection, and some time later that the infection began in the fallopian tubes, and that whatever of pelvic cellulitis there was, was secondary to the tubal infection. And still later we learned that in the majority of instances pelvic hæmatocele is due to an ectopic pregnancy. It is now well established that infection of the fallopian tubes is the most common condition in the pelvis requiring surgical treatment. The entrance into the tubes from the uterine side is very small, and it would seem as if it were one of Nature's wise provisions to prevent the entrance of bacteria into the peritoneal cavity through the natural channels. On the contrary, the fimbriated extremity of the fallopian tube is wide open, and if any bacteria are present in the peritoneal cavity it would be very easy for them to gain entrance to the tube. The tubes normally are sterile, although occasionally they are found to contain bacteria without symptoms of infection. Under normal conditions the uterine end of the tubes are further protected by a sterile uterus and they do not become infected until after an infection of the uterus. In other words, the tubes are not liable to infection from the uterine side except under abnormal conditions. Is it therefore not rational to conclude that when abnormal conditions obtain within the peritoneum that the tubes may be infected from the peritoneal end? When abscesses were first found within the tubes the contents were reported as sterile but better technique has enabled us to demonstrate various forms of bacteria in these abscesses.

In 1886 Westermarck first discovered the gonococcus in these abscesses. Following this discovery the profession went to the

extreme, as it too often does, and many articles were written supporting the belief that all cases of salpingitis were due to the gonococcus infection. At the present time it is well established that while the majority of cases of salpingitis are due to a gonococcus infection, there are many due to infection from other bacteria. The bacillus coli has often been found in salpingitis and has been considered due to intestinal adhesions. Kelly says that bacteria may escape from the appendix and infect the tube, and quotes a case of Robb's in which one tube in a double pyosalpinx gave a negative culture and on the other side the tube was closely adherent to an inflamed appendix and contained streptococci. Salpingitis is often complicated by appendicitis. May not one be the cause of the other?

In a recent paper by Goldstine,² 328 cases of salpingitis are reported, of which 197 gave positive evidence of gonococci; 43 were of puerperal origin; and 86 from other sources. In 12 cases the appendix was firmly attached to the right tube and ovary, and in 5 of these the right tube only was involved, which would seem to be positive evidence that the tube was infected from the appendix.

A number of years ago the writer's attention was first called to the possibility of appendicitis being the cause of salpingitis by the following case.

A single woman, age 30, was brought from one of the smaller cities of Minnesota to Minneapolis for operation with a diagnosis of salpingitis. She was taken to a gynecologist who firmly believed that the only cause of salpingitis was infection from the gonococcus and in the absence of any evidence of infection in the vagina and the presence of an imperforate hymen concluded that it was impossible for the patient to have salpingitis, and discredited the attending physician's diagnosis. The patient was then brought to the writer, who found that the patient gave a history of repeated attacks of inflammation in the lower abdomen and pelvis, and by rectal examination a solid mass could be made out in the pelvis. The vagina was healthy and the hymen intact. There was no history of disease or

¹ Surg. Gynec. & Obst., 1915, xvi, 250.

² Read before the Southern Surgical and Gynecological Association, Cincinnati, December, 1915, 1915.

unnatural discharges from the vagina at any time. The diagnosis of salpingitis was confirmed, although the possible cause was not understood. Operation was performed by the writer, who found evidences of repeated attacks of appendicitis, found the appendix closely adherent to the right ovary and tube, and both tubes distended with pus. The appendix and tubes were removed, and the patient fully restored to health. It is evident that the infection had not extended to the uterus, because it was left and has never caused symptoms. This led the writer to conclude that this was a case of salpingitis secondary to appendicitis.

This occurred many years ago at a time when facilities for careful bacteriologic examinations were not at hand, so that we had no means of knowing what bacteria were present. Since that time the writer has observed a number of cases that have confirmed his conviction that some cases of salpingitis are due to an infection from the peritoneal side caused by an appendicitis, but only two more cases will be cited to emphasize the point we are trying to make.

CASE 2. A woman 39 years of age had been married a number of years and had never conceived. She spoke a foreign tongue little used in this country and it was very difficult to get an accurate history, but we learned that she had had repeated attacks of abdominal inflammation which resulted in chronic invalidism. Upon entrance to the University Hospital a physical examination showed marked tenderness over the lower half of the abdomen particularly over the pelvis, and in the left pelvis a mass could be made out which was evidently an inflamed tube. A median incision was made and a large hydrosalpinx of the left tube removed. On the right side the ovary and two thirds of the tube were absent. There were extensive adhesions and the appendix, which had undergone many changes from inflammation and was tightly bound down was removed. This woman had had no previous operations but owing to our inability to talk with her we were unable to get a satisfactory history of an abscess having discharged through the bowel. Yet it seems to me that the only way that the absence of this right ovary and tube can be accounted for is that there has been an inflammation beginning in the appendix and extending to the right tube and ovary, which ended in extensive abscess and sloughing and was all discharged through the bowel. The uterus did not seem to be enlarged or infected, but was retroverted and was fastened forward by the use of the round ligaments.

CASE 3. A trained nurse, aged 23 was admitted to the University Hospital July 10, 1915 complaining of pain in the pelvis and right lower abdomen. She had a temperature of 102.5° leukocytes 22,900

polymorphonuclears 84 per cent. Upon physical examination there was marked tenderness over the lower abdomen and pelvis, but no muscular rigidity. Deep pressure over the right iliac region together with pressure in the loin elicited severe pain. This was the location of her severest pain. Upon vaginal examination the uterus was found freely movable and not sensitive. The right tube was distended but floating freely, and was not particularly sensitive. It was decided that the pelvic condition did not account for the temperature and blood picture, and from the pain elicited by pressure over the right loin and right lower quadrant of the abdomen a diagnosis was made of acute retrocecal appendicitis. This diagnosis was based upon the location of the pain and tenderness and the absence of muscular rigidity. An incision was made and the appendix found behind the cecum and extraperitoneal with the exception of a very small portion of its tip. It was dissected out and removed and upon section proved to be full of pus. The patient gave a history of having had like attacks before and there were many adhesions showing there had been a previous appendicitis. The right tube could be felt quite markedly distended but freely movable. The left tube was normal. The distended tube was not removed, and the abdomen was closed. By midnight her temperature had dropped to 100° and the next morning was 99°. Leucocytes and polymorphonuclears dropped promptly and were gradually reduced to normal. After this time the temperature ranged from normal to 101° most of the time being in the neighborhood of 99° which could be accounted for from her salpingitis. On the fourteenth day after the operation she was allowed to sit up and her temperature immediately rose to 102°, with return of pain in the pelvis. This again disappeared when she was put to bed. On August 21 she had been sitting up some days with comfort and was allowed to go home with a temperature of 99°. In other words her convalescence gave a picture of a convalescing subacute salpingitis. There was no history of vaginal infection and smears were negative. It seems to the writer that the only rational conclusion to be arrived at in this case is that this woman had appendicitis which infected the right tube. The left tube it will be remembered, was normal.

We believe that these cases demonstrate that infection of the fallopian tube may occur from the peritoneal end, and that when it does it is usually due to appendicitis. We believe that it should be accepted as an established fact that a certain small percentage of cases of salpingitis are due to appendicitis so that when looking for possible causes of a pelvic inflammation we may take this fact into consideration.

ULCER OF THE JEJUNUM

WITH REPORT OF A CASE¹

BY ROBERT C. BRYAN, M.D., F.A.C.S., RICHMOND, VIRGINIA

VAN ROOJEN has been able to collect from literature three cases of apparently undoubted peptic ulcers of the jejunum in whom no previous gastroenterostomy had been performed. He says "The jejunal peptic ulcer is one which manifests itself in its outer appearance, its symptoms, as well as results, analogously to the peptic ulcer of the stomach, with the difference that while no tangible cause can as a rule be attributed for the development of the gastric variety of this ulcer, the jejunal is practically always a sequela of an antecedent gastroenterostomy. I say practically always, in the literature on the subject, this relationship is considered a constant one. I know, however, of three cases of jejunal ulcer where no antecedent gastroenterostomy was performed." In 1861, that is 20 years before the first gastroenterostomy was performed, Wagner reported such a case. Professor Rotgans while performing a gastroenterostomy for a peptic ulcer of the stomach discovered during the operation, a peptic ulcer of the upper part of the jejunum. Dr. Schoo, the pathologist at the Wilhelmina Hospital at Amsterdam, informed Van Roojen of having found two such spontaneous ulcers of the jejunum at autopsy.

That anatomic deviations and anomalies may be found in the upper abdomen, is frequently observed. Normally the duodenum and the jejunum are continuous but the following differences may be noted. In the duodenum the glands of Brunner are found which penetrate the muscularis mucosa, their fundi lying in the submucosa. These glands are not found in the jejunum or in the ileum. They manufacture an alkaline juice which with the glands of Lieberkuhn that are found in the duodenum, along with the product of the pancreas, produces the succus entericus. The muscular coat of the duodenum is thicker than that of the jejunum and the normal habitat of germs is also

different in these two segments of the gut. The most striking anatomical variation is the fixed position of the duodenum with its anterior mesentery and generous blood supply. The thin jejunum, on the other hand, enjoys a large excursion, being fixed only at its proximal end. Its minimum mobility is therefore greater than the maximum of the duodenum. It has a complete mesentery and is swung vertically.

The case to be reported is W. H. M., age 48, white, inspector. Family history negative, but for one sister who died of cancer. Father alive at 80. Usual mild diseases of childhood.

He had typhoid fever 25 years ago and was confined to his bed several months. He was operated on for mastoiditis 23 years ago in New York and has had continuous rubber drainage ever since, and is entirely deaf on the left side. His leg was broken 15 years ago, good result. He had measles 6 years ago and was very ill but there were no complications. He never drank or used tobacco. In the last four years he has had severe attacks of indigestion with increasing frequency of late, characterized by violent cramps in the region of the stomach. He has always been a hearty eater and chronically constipated. Two years ago he had constant pain and nausea which continued for four months. He vomited constantly but he never noticed any blood in the vomitus. He then consulted a physician who said he had an ulcer of the stomach. He was now thoroughly incapacitated for work of any kind and lost considerable weight and strength. At this time he started washing out the stomach which always made him feel better. The washings were green with yellow mucus. The pain would come on from two and one half to three hours after eating. Recently in the last few months, there had been persistent pain and nausea but no vomiting, although there was a constant desire to eat or drink something, and he had noticed that he could not eat very much at a given time. For several years he had used strong liniments on the pit of his stomach. Thus, with a hot water bottle, was his accustomed treatment. He did not believe in medicines and would not take them. The patient had been unable to do any regular work in the past three years, and consulted many physicians, who said he had cancer of the stomach, spasm of the pylorus, appendicitis, and ulcer of the stomach.

September 8, 1915, at 1 a.m. while employed

¹ Read before the Southern Surgical and Gynecological Association on Cincinnati, December 13-15, 1915.

as an inspector in a munition factory, he was suddenly seized with a most agonizing pain in the abdomen and groins. This pain was unlike any that he had ever had before. He was found about an hour later by some of his fellow workmen in a collapsed condition, and brought to Grace Hospital at 3 a m two hours after the sudden seizure.

When seen by the writer at 8 a m the patient was fairly comfortable, the pain had been controlled by morphine, the face was drawn and pale, and the extremities cold, pulse 104, temperature 96, respiration 22. There was persistent nausea and frequent attempts to vomit, but nothing came up. An insatiable thirst was very distressing. The abdomen was bowed hard. There was no area of tenderness greater than another, a most annoying and painful pruritus persisted throughout the day. The catheter gave two ounces of urine which was acid, 1,030 moderate amount of albumin, occasional red blood cell, no pus, few hyaline and several fine granular casts, phosphates normal, no sugar, no chlorides, indican, acetone, diazo and urobilinogen negative. White blood cell count 8,400. Liver dullness absent heart sounds distant but clear. Respiration shallow. The picture was that of acute abdomen and the diagnosis of probable perforation of ulcer of the stomach was made.

The patient positively refused operation and only consented at 8 p m, 17 hours after the onset, with temperature 101° pulse 124 and respiration 38.

Ether anesthesia right rectus incision. The peritoneal cavity was full of greenish fluid with flakes of lymph and food particles floating about in it. The stomach was atrophic, hard bound down, pulled to the left and firm, the walls white and heavy the omentum shrunken and thick. The duodenum was plastered down the jejunal wall was likewise indurated, whitish and thickened and on its anterior wall about three inches from the duodenojejunal juncture, a round punched out ulcer, the size of a cherry stone, was found. The induration of the jejunum extended several inches below the point of perforation and tapered off gradually in the jejunal wall. The patient's condition was desperate on account of the great thickening, diminished lumen, and fixed position of the stomach duodenum and jejunum no anastomosis could be made, purse string and invagination were impossible. A piece of omentum was plugged into the opening and several retaining catgut sutures sowed over it. The belly was irrigated with warm saline. A large drainage tube was inserted and a stab wound made into the pelvis. The patient died the next morning at 10 o'clock. Autopsy was refused.

JEJUNAL ULCER FOLLOWING GASTRO-ENTEROSTOMY

In 1899 Braun first described this complication and although the subject has since

received considerable attention in Germany by Hahn, Kausch, Schwarz, and Korte, Keen's case in 1904 was the first described in English records. Mikulicz, Pinner, Tiegel, Mayo Robson, von Haberer, Van Roojen Paterson in his Hunterian lectures, and Gosset, contributed the early literature on this topic. Extremely interesting experimental studies have also been carried out by Exalto, Katsenstein, Hotz, Kathe and Wullenstein, and more recently by Sorei of New York.

FREQUENCY

Statistics show that jejunal ulceration occurs in 15 per cent of all gastro-enterostomies. Keen states that all of these cases were of the perforating character, and therefore were not recognized, causing death by abscess, or in other ways in which adhesions and complications so obscured the parts that even an autopsy failed to reveal the true nature of the disease.

Mikulicz says that in 34 instances in which the location of the gastro enterostomy anastomosis was mentioned 25 times it occurred in the anterior and 6 times by the posterior method. In the posterior operations the jejunal opening is about 9 inches distant from the beginning of the jejunum, in the anterior it is from 16 to 20 inches distant from this point. It would appear therefore, that the lower the point of anastomosis in the jejunum, the more susceptible the mucosa to the digestive action of the peptic juices.

- 1 The ulcer developed rapidly and perforated shortly after operation.
- 2 The ulcer developed in a few weeks or a month after operation suggesting a recurrence of the former trouble.
- 3 The ulcer developed slowly and in siduously, undergoing a subacute perforation.
- 4 The ulcer perforated into a hollow viscus.

ETIOLOGY

That ulcers of the intestine frequently occur has been well established. Most of them are superficial, heal spontaneously and consequently possess no surgical interest. As a rule they are merely the expression of a

general disease such as gout, syphilis, scurvy, anthrax, leprosy, tuberculosis, dysentery or erysipelas. Any form of intestinal ulcer may lead to perforation. The duodenal perforation following extensive burns has been frequently recorded.

Age—The age in jejunal ulcers following gastro-enterostomy does not seem to play an important rôle. Of the 146 cases collected by Schwarz in 1914, the youngest patient was 10 months old, while the oldest had reached the age of 70. The disease occurred most frequently between the ages of 30 and 50.

Sex—It has been supposed that the predisposition of the male is perhaps due to the fact that men are most apt to be indiscreet about eating and drinking, especially alcoholic indulgences, and that their greater participation in the more strenuous demands of life likewise predispose them to this affection. Pinner would add to this excessive smoking.

Time—The jejunal ulcer develops most frequently within the first six months following the original gastro-enterostomy. Of the 146 cases above referred to, 50 developed within this period, 22 within the second half year, 23 within the second year, 20 between the second and fifth years, and 13 between the fifth and tenth years. According to Pearson, rough handling, marginal bruising, and excessive dragging on the parts, the use of blunt instruments in effecting the opening into the stomach and bowel, and the injudicious tight application of clamps and forceps hematoma emboli, tension traction, are the factors following gastro-enterostomy which do the mischief.

Next in importance is sepsis, either as the result of infection at the time of the operation or already existing in the diseased stomach. Insufficient blood supply resulting either from excessive tension of the sutures, or due to thrombosis in the vessels around the anastomotic opening.

The presence of a foreign body is a frequent cause according to Pearson of the gastrojejunal variety of this complication, and the most frequent foreign body, as well as the most frequent source of irritation, is the prolonged retention of an unabsorbable inner suture.

Paterson offers the three following suggestions as the cause of jejunal ulcerations:

1 That jejunal ulceration is due to circulatory disturbances in the attached jejunum.

2 That jejunal ulcer is an infective process.

3 That jejunal ulcer is due to the digestive action of gastric juice on mucous membrane accustomed to the presence of alkaline contents only. Paterson holds to the view that such ulcerations are toxic in origin and states that "this toxic agent usually present is hydrochloric acid, but that other toxic agents may possibly be present and either may increase the effect of the other."

Thus a small percentage of free hydrochloric acid in the jejunum which by itself would not cause ulceration, in the presence of some other toxic agent, might produce ulceration. The circumstances under which free hydrochloric acid may be present in the jejunum are—

1 Hyperacidity of the gastric juice so that the bile and pancreatic juice are unable to neutralize completely all the acid entering the jejunum.

2 Normal percentage of hydrochloric acid in the gastric juice but excessive secretion, so that the amount of hydrochloric acid discharged into the jejunum is greater than can be neutralized.

3 Diversion of the course of the bile and pancreatic juice so that the jejunum is exposed to the action of gastric fluids unmixed with the bile and pancreatic juice, as in certain operations.

4 Normal acidity and normal amount of gastric secretion but incomplete neutralization in the jejunum, owing to temporary diminution of the flow of the bile and of the secretion of the pancreatic juice.

Moynihan is inclined to the idea that jejunal ulcers are always secondary to an infective process elsewhere, most likely in the abdomen.

Pinner in commenting upon the reported cases doubts from the available anatomical description if they were actually peptic ulcers.

From time to time various theories based

upon anatomical, clinical, and experimental considerations have been brought out, but ever since Tiegel expressed in 1901 his belief that the chief cause of these ulcers following gastroenterostomy is to be found in the deleterious effect of the acid gastric juice upon the mucosa of the jejunum a tissue not accustomed under normal conditions to this chemical agent, all authorities are inclined to concur in this opinion. Despite the fact that not an inconsiderable number of cases have been reported in which the hydrochloric acid content of the gastric juice was normal or even subnormal.

Keen thinks that a mild form of sepsis leading to an excess of free hydrochloric acid in the gastric juice, traumatism either by coarse food or through external injury, and interference with the circulation in the bowel must be considered as possible causes.

Von Bergmann states that if the gastric juices pass directly into the jejunum a typical gastric ulcer may be produced the gastric juice being found to contain excess acid.

Quitt in the *American Practice of Surgery* declares that ulcer of the jejunum has never been found following operation for pyloroplasty or gastroduodenostomy. In pyloroplasty and gastroduodenostomy the acid secretion is neutralized by mixing with the bile, pancreatic juice and succus entericus. Mikulicz reports a case of a child three months old in whom an ulcer formed following an operation for congenital stenosis of the pylorus. H. J. Paterson states that in most instances, hyperchlorhydria is due to the insufficient use or inefficient working of the anatomic opening also that arteriosclerosis of the blood vessels of the mesentery or kinking of these structures may interfere with the blood supply and so predispose to the formation of ulcer.

The above are some of the theoretical explanations of a condition which to the writer is apparently directly contingent upon an acid autodigestion, for ulceration lower down in the alimentary tube following an enteroenterostomy or enterocecolostomy is unknown, in other words the acid chyme of the stomach is done away with in these

anastomoses, as only alkaline products are found from the pyloric ring to the rectum.

EXPERIMENTAL

The theory of hyperaciditation is supported if not in its entirety, certainly to a very large extent by some of the foremost surgeons. Schwarz dismisses the etiologic consideration with the terse sentence "Where the gastric juice has no access there is no peptic ulcer." It is further confirmed by some of the experimental work carried out by Katzenstein, Wulfenstein and Kather, who sutured into the stomach of the dog loops of intestines and parts of other organs and observed the deleterious effects of the gastric juice upon the living non-stomach tissue of this animal. They assume that the stomach mucosa secretes a neutralizing antiferment which renders this tissue immune to the effects of the gastric juice.

Katz and Lialko carried out similar experiments and came to the conclusion that the disintegrating effects observed by the former investigators were due to interference with the blood supply of the invaginated part and that whenever sufficient precautions were taken to avoid circulatory disturbance, no digestive effects were observed. What ever these experimental studies may mean, certain it is that the clinical facts point strongly to the correctness of the hydrochloric acid theory for the complication follows much less frequently those operations which do not prevent the neutralizing alkaline fluids of the gall bladder and pancreas from reaching the gastric juice and becoming mixed with it in short those operations which do not deprive the patient of this "inner drug shop" as Roux aptly termed it.

And Key¹ records but one case of ulceration of the jejunum following gastroenterostomy for carcinoma of the stomach. Rowlands was unable to find any such case. This apparently corroborates strongly the acid theory of jejunal ulcer formation.

Wilks in 1910 performed gastroenterostomies of different types upon a number of cats and later administered to these animals hydrochloric acid in various amounts

and noted the effect of this upon the subsequent development of jejunal ulcer.

Exalto performed gastro enterostomies in two series of dogs, seven in each series. In the first series he performed the ordinary anterior and posterior retrocolic gastro enterostomies, while in the second series he used Roux's operation, in some anteriorly and in others posteriorly.

The dogs of the first series after uneventful recoveries from the operation, showed no subsequent involvement of the intestines, and in three of those who were killed, the autopsies showed no signs of ulcer formation in the jejunum. On the other hand, of the seven dogs in the second series, five died of a perforative peritonitis due to a jejunal ulcer, and of the two others who were sacrificed only one was free from this complication.

It is rather interesting to note that in the specimens photographed and fully described of the jejunal ulcer following gastro enterostomy which the writer has seen the necrosed area was located opposite to the new hiatus or in other words, in the direction of the flow of the gastric contents.

LOCATION OF DUODENAL ULCERS

Moynihan divides the stomach from the duodenum by that important land mark, the pyloric vein. He says "it runs generally a little to the gastric side of the pylorus, is constant and its recognition allows one to see instantly where the stomach ends and the duodenum begins. It runs upward from the greater curvature is thick and short. If this landmark be taken as the beginning of the duodenum, 95 per cent of the total number of cases of ulcer lie within the first portion of the gut, that is, within one and one half inches of the pylorus."

Lustermann says that the average ratio of gastric to duodenal ulcers is about 1 to 3, that is 75 per cent of all ulcers are duodenal. Of 814 cases of duodenal ulcer, 77 per cent were in males and 23 per cent in females. Wilkie has explained this on an anatomic basis.

In Collin's series there were in the 262 cases 242 in the first part, 14 in the second, 3 in the third, and 3 in the fourth.



Fig. 1 Stomach shows great thickening, walls white and heavy, organ markedly contracted and bound down to the left of the median line.

In Perry and Shaw's series of 149 cases, there were 123 ulcers in the first part of the duodenum, 16 in the second, and 2 in the third and fourth. In 8 instances the ulcers were scattered.

Moynihan says "The first part of the duodenum is especially prone to attack. It may be that against it the jet of chyme directly impinges as it is expelled through the pylorus." In other words, after the neutralizing effect of the duodenal and pancreatic juice have become evident there is no ulcer formation.

Theoretically then, if a severe acid chyme, not enjoying the beneficent effects of alkalization would be hurriedly emptied through the duodenum into the jejunum, it would appear from a review of the literature and experimental work, that ulcer of the jejunum by this autodigestive process should take place. It has therefore occurred to the writer that the explanation of this necrosis rests not so much with an actual hyperacidity, as it does with a prolonged and intermittent failure of proper alkalization by the normal ferments which should be found present in the duodenum. A transient cholæmia, interstitial pancreatitis or duo-

hritis constitutional diseases psychi, neu-
rotic or hysterical influences may lessen or
inhibit this alkaline product and thus per-
mit the acid fluid to reach the jejunal mem-
brane uncontrolled or modified by alkaline
juices. These jejun would be all the more
likely with this state of affairs if associated
with duodenal abnormalities such as shorten-
ing anomalous blood supply and an early
or mesial duodenojejunal junction.

The writer's case of jejunal ulcer was
associated with the pathological states of the
stomach duodenum and jejunum already
mentioned apparently a cirrhosis of the
stomach linitis plastica or the gastro-
intestinal sclerostosis of Kumpfecher.

In 1860 (Gleuge of Germany first described
a case of complete cirrhosis of the stomach.
Hrant tells us of a case in which the lesion
was found in the stomach and caecum. By
these authors the disease was held to be
benign. Kumpfecher holds that gastro-
intestinal sclerostosis is not a mere disease
of the pylorus but is found in the intestines
and peritoneum and that it is the result of
a chronic venous edema caused by cirrho-
sis of the liver and arteriosclerosis and that
the pathological process bears a close relation
to sclerodermia.

Hunt states that with the great thick-
ness the mucosa is often normal in appear-
ance the secretory structures remaining
substantially healthy.

Lyle in his article "Linitis Plastica" states
"In the majority of cases evidences of an
associated subacute or chronic peritonitis are
prominent lymphon the walls of the intestines
fibrous adhesions ascites thickening and opac-
ities of the lesser and greater omentum
white, waxy like plaques on the visceral and
parietal peritoneum with thickening of the
retroperitoneal tissue (the retroperitoneal
callus of Hanot and Combault).

From the hurried operation and great
haste made necessary by the condition of
the patient the writer would not care to
venture an opinion whether this was a case
of linitis plastica with a consequent jejunal
ulceration or whether it was primarily an
ulcer formation with perforation associated
with many other old healed ulcers in the

duodenum and stomach resulting in great
induration and thickening. The latter is
probably the most tenable.

DIAGNOSIS

There being no literature upon diagnosis
our investigations must be limited to or
deduced from jejunal ulcers developing
after a previous gastroenterostomy.

Mayo Robson says

If, after a period of good health subsequent to
the operation of gastroenterostomy, a patient
begins to complain of acidity, flatulence and dis-
comfort after meals followed after a time by definite
pains from an hour to two or three hours after food
and relieved temporarily after taking milk or some
other light diet or some form of alkali if the pain
occurs on the left side of the umbilicus and is
associated with marked tenderness and rigidity
of the left rectus the suspicion of ulcers of the jeju-
num is raised. Hematemesis or melena or even the
presence of occult blood in the feces will make the
diagnosis fairly certain but if with all these symp-
toms a swollen and tender loop of bowel can be
felt in the region of the anastomosis or below and
to the left of the umbilicus the surgeon can no
longer be in doubt as to the nature of the disorder.

Barson from whom we quote liberally,
says

Epigastric pain is the most constant symptom
usually it begins in relation to the taking of food
but is dull aching or stabbing in character and
more or less persistent. In some instances however
it closely imitates the paroxysms of ulcer pain a
meal often being attended followed after a definite
interval of exacerbation. The pain is usually in the
middle line or slightly to the left and above the
umbilicus and might strike through to the back
when most acute. Epigastric distress, fullness,
flatulence and eructations of sour gas with acid
dyspepsia may occur. Vomiting is not frequent hema-
temesis and melena are rare. Loss of weight will
probably be observed especially if the patient
has enjoyed a period of good health before the
onset of symptoms. Next in pain epigastric
tenderness corresponds in position to the pain being
more commonly to the left of the median line. A
variable degree of muscular rigidity may be present.

Another objective sign upon which very
much stress is placed by Barson in the
Wiener Klinische Wochenschrift 1914 is fur-
nished by the roentgenologic examination of
the jejunum. He believes that an intense,
spotlike shadow which breaks through the
filling in the jejunum and partly extends over

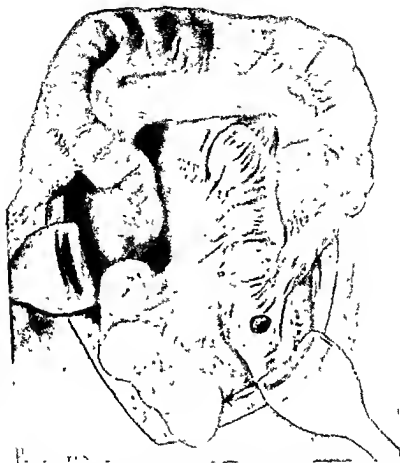


Fig. 2. Jejunum greatly indurated, the mesentery shrunken, its walls white and hard. Perforation shows about 3 inches from the duodenojejunal junction.

the contour of this viscus which furthermore remains uninfluenced by lavage and the locality of which is tender to pressure is characteristic of post operative jejunal ulcer.

But these are the diagnostic measures worked out for that variety of jejunal ulcers which follow gastro enterostomy.

With necrosis and mural disintegration the degree of pain is accurately adjusted to the proximity of the pathological process to the peritoneal investment the writer would venture to state that in ulceration of the duodenum there is more pain and a longer course with the ulcer in the anterior or peritoneal wall than obtains upon the poste-

rior or uncovered wall. This pain is aggravated by functional activity and, according to experiments by the presence of hydrochloric acid. On the other hand it is controlled by rest and alkalines. This pain is to the left of the median line at times referred to the back, is more localized in the upper abdomen and like most pain in the small intestines is temporarily bettered by a gentle pressure. It may radiate to the groins along the spinal column toward each renal fossa, in short assumes the varied characteristics of location or intensity of the pain of a localized inflammation of the small intestines, which is constantly referred in its

FRACTURE OF THE NECK OF THE FEMUR¹

A STUDY OF THE TREATMENT AND END-RESULTS IN FIFTY-FIVE CASES

BY ALEXIUS MCGLANNAN, M.D., F.A.C.S., BALTIMORE

THE system of arches formed by the bone plates in the cancellous tissue of the neck of the femur, makes an ideal arrangement for lightness of construction with a maximum of weight-bearing capacity. The interaction of the arches one on another is necessary for carrying the weight of the body and the strain of its movements in the erect posture. When the neck of the femur is broken, this mutual relation is disrupted, and unless the arches are restored, in the process of healing, either the neck will bend at the site of union of the fragments or a greatly increased mass of bone must be formed to provide rigidity. Either alternative results in a permanent deformity.

Therefore accurate apposition of the fragments becomes an essential in the treatment of this fracture and sufficient time must be allowed for complete bone regeneration before weight is put on the united fracture if deformity is to be avoided.

The position of the separated fragments in the fracture is as follows. The shaft fragment is drawn up above and behind the head fragment the trochanter is rotated backward carrying the foot into eversion, the lower end of the femur is drawn toward the middle line by the adductors. The head remains fixed in the acetabulum and the broken end of this fragment is directed upward and slightly forward.

In almost every case some portion of the periosteum remains attached to both fragments and when the fracture is in a suitable position on the neck a portion of the capsular ligament is likely to bridge the separation of the bone.

The positions described give the general direction of the fragments, the relative positions of which vary in degree with the seat of the fracture. Several classifications have been advised to separate these fractures into groups according to the position of the break.

Kocher's classification into subcapital, fracture at the junction of the head and neck, intertrochanteric, along the line between the trochanters, and pertrochanteric, obliquely through the trochanters, is used in our hospital records.

The blood supply of the neck of the femur is peculiar and the effect of a fracture on the circulation of the head fragment is an important factor in the healing of this lesion.

Lexer's² study of the circulation in bones shows that the blood supply to the neck of the femur enters from four points. The first, an epiphyseal artery at the insertion of the ligamentum teres, a second just at the line of junction of the head and neck on the upper surface, a third near the great trochanter, and a fourth the largest of the group, a metaphyseal artery near the lesser trochanter. Lexer states that the blood supply is greatest in childhood and that in adult life the most marked change is seen in the diaphyseal group of arteries supplying the shaft which become smaller and smaller with advancing age. The narrowing of the other two groups in the region of the epiphysis is less distinct while the arterial supply of the joint apparatus becomes much more marked.

All these arteries reach the bone by way of the periosteum and the capsule. The importance of any attached and untorn area of these membranes is at once apparent. The fracture must have a profound effect on the circulation of the head fragment because whenever this fragment is exposed at operation for non union the blood supply is diminished in proportion as the seat of fracture approaches the subcapital type.

Here again accurate approximation offers the best chance for good union diminishing the need for new bone formation and giving the best opportunity for improvement in the local circulation.

¹Arch. & Min. Clin. 1904, 12:10, 431.²Read before the Southern Surgical and Gynecological Association, Cincinnati, December 13, 15, 1915.



Fig. 1. Ice tongs extension. Shows the bandaged leg, and the ice tongs covered in by the gauze dressing. The small board between the handles assists in maintaining inward rotation.

Reduction of this fracture is accomplished by downward traction and internal rotation of the femur with the limb slightly flexed and widely abducted. The method of reduction and of fixation varies with several authorities but the essential principle is expressed above and has for its object the complete correction of the deformity caused by the position of the fragments.

Bardenhauer obtains gradual reduction by weight traction acting simultaneously in several directions. Slightly modified this is the method of Maxwell and Ruth. Whitman reduces the fracture by manipulation under anesthesia using the completely abducted sound hip as a lever for fixing the pelvis. While forcibly carrying the fractured limb to the limit of abduction he presses down on the trochanter and at the same time lifts it forward, so as to overcome the external rotation. Both hips are slightly flexed in wide abduction and a plaster cast is applied from the toes to the nipple line on the injured side and a short distance on the sound



Fig. 2. Ice tongs extension. Shows the position of the patient on the Catch bed, and the overhead beam with its soft bandage, by means of which the patient shifts her position (Case 20).

side in order to securely fix the pelvis. A pad is placed behind the trochanter to support it and thus secure inward rotation.

Much criticism has been made of Whitman's forced abduction, and the method has been condemned on the ground that the wide abduction is not required for all types of these fractures and that overabduction would lead to malposition of the fragments. We have demonstrated at operation with the fracture open, and on a postmortem specimen that abduction is essential to apposition and that after this point has been reached further abduction does not disarrange the fragments, because the taut capsule and other soft parts carry both fragments together to the limit of movement. This is an important point, because while it is almost impossible to calculate the exact degree of abduction that will give the best apposition in any particular fracture the knowledge that complete abduction will surely carry the fragments out together gives us a definite position in which to fix the injured limb.

Impaction is most often a penetration with crushing and little fixation. Except in the rarest of cases the bones are driven into one another with adduction of the limb. Union in this position therefore gives great deformity and is the cause of most of the disability in addition to fracture of the neck of the femur.



Fig 3. Tying out. Showing both knees made fast to the board spreader, after abduction. Fracture on the left side. The spreader also prevents rotation of the bandaged thighs.



Fig 4. Tying out. View from the side. Note the sand bag under the trochanter, correcting the outward rotation of the femur. The position of the foot is due to eversion below the knee. The cords fixing the spreader to the bed rail, and the pillows on the outrigger, under the foot, have been removed, in order to make the picture clearer. (Photographs by Dr J. I. Bartlett.)

There is no doubt of this being the case in those individuals who are incapacitated although their fracture has united. Therefore impaction should be broken up by a gentle hinge like motion and the fragments be brought into apposition in abduction when ever there is hope of treating the patient.

The cases¹ now being reported were all treated on this general plan, but with several modifications of the details both as to reduction and fixation. The modifications may be grouped into six classes and in this way the cases will be reported.

Class A. Reduction under anaesthesia fixation in abduction by means of lateral wire splints and interrupted plaster bandages.

Two mattresses are placed on the bed over a special frame of slats to give rigidity. This frame should extend beyond the bed on either side or a single bar about six feet long may be placed transverse to the long axis of the bed near the foot. To this the legs are bandaged to keep up the abduction. A bar placed between the knees fulfils the same purpose.

The first dressing is removed at the end of two weeks and subsequent dressings are made weekly. The knee on the sound side is left free at the end of two weeks, the sound leg at six weeks. In from seven to ten weeks all

dressings are removed and the patient kept on crutches for at least three months longer.

This was our original fixation. In this way we treated five cases, three women and two men.

Class B. Reduction under anaesthesia, fixation in heavy plaster of-Paris cast, extending from toe to nipple line on the fractured side and taking in the sound thigh for a short distance.

Twenty patients were treated by this method, ten women, nine men, and one boy sixteen years of age.

Class C. Adhesive plaster traction in two directions (abduction and inward rotation). Two patients were treated by this method, both fat women severely handicapped.

Class D. Direct traction by means of ice-tongs. This method was suggested to me by Dr Ransohoff at the meeting of this society two years ago. It has been used in three cases. In one case an impaction was separated under anaesthesia preliminary to the traction. The ice tongs are clamped into the femur through a small wound on either side just above the condyles, and are held in place by a sterile roll of gauze which, winding around the thigh and the blades of the tongs, makes the dressing for the wounds. The

¹ This paper is based on a study of 31 cases of fracture of the neck of the femur observed in St. Ann's and Mercy Hospitals Baltimore. Of the former 22 patients were under the care of Dr. H. Wolford or were put up by the Kentucky Surgeons all 9 were at some time in the course of their treatment came under my personal observation. Of the latter group those cases occurring previous to 1915 were treated by me as Assistant Surgeon on the service of Dr. A. S. Nixon. The later cases came to me when I succeeded him as chief of this service.

RECENT FRACTURES

Number	Date of Injury	Age	Sex	Occupation	Position of Fracture	Position	Anesthetic	Immediate Result	Time in bed	Period of complete Disability
1	Mar 1907	60	M	Housewife	Intertrochanteric	A	Ether	Union	63 days	37 days
2	Aug 1907	41	F	Housewife	Subcapital	A	Ether	Union	50 days	151 days
3	Sept 1907	65	F	Housewife	Subcapital	A	Ether	Union	77 days	0 mo.
4	July 1908	71	M	Restaurateur	Impacted intertrochanteric	A	None	Union	70 days	173 days
5	Mar 1909	68	F	Cook	Intertrochanteric	A	E blood am.	Union	65 days	70 days
6	Jan 1907	55	M	Farmer	Impacted intertrochanteric	B	Ether	Union	65 days	212 days
7	Feb 1907	41	M	Subst. boy	Subcapital	B	Ether	Union	64 days	720 days
8	Jan 1909	71	M	Rest. red.	Intertrochanteric	B	E blood am.	Union	83 days	115 days
9	Oct 1909	71	F	Housewife	Intertrochanteric	B	E blood am.	Union	75 days	81 days
10	Aug 1910	46	M	Mechanic	Intertrochanteric	B	Ether	Union	71 days	117 days
11	Jan 1911	50	F	Housewife	Intertrochanteric	B	Ether	Union	71 days	71 days
12	July 1911	42	F	Housewife	Impacted intertrochanteric	B	Ether	Union	68 days	47 days
13	Dec 1911	60	F	Housewife	Intertrochanteric	B	Ether	Union	80 days	1 year
14	Feb 1912	40	F	Housewife	Impacted intertrochanteric	B	Ether	Union	70 days	115 days
15	May 1912	60	F	Housewife	Intertrochanteric	B	Ether	Union	61 days	80 days
16	Jan 1912	41	M	Tailor	Impacted subcapital	B	Ether	Union	60 days	64 days
17	Feb 1912	37	M	Laborer	Intertrochanteric	B	Ether	Union	68 days	70 days
18	Feb 1912	46	M	Laborer	Intertrochanteric	B	Ether	Union	71 days	70 days
19	July 1912	60	F	Housewife	Intertrochanteric	B	Ether	Union	70 days	101 days
20	July 1912	41	M	Housewife	Intertrochanteric	B	Ether	Union	71 days	115 days
21	Nov 1912	41	M	Laborer	Intertrochanteric	B	Ether	Union	71 days	115 days
22	Dec 1912	41	M	Laborer	Intertrochanteric	B	Ether	Union	71 days	115 days
23	Mar 1913	61	F	Housewife	Intertrochanteric	B	Ether	Union	71 days	115 days
24	Sept 1913	60	F	Housewife	Intertrochanteric	B	Ether	Union	71 days	115 days
25	Jan 1913	23	F	Housewife	Intertrochanteric	B	Ether	Union	71 days	115 days
26	June 1913	23	F	Housewife	Intertrochanteric	B	Ether	Union	71 days	115 days
27	Nov 1913	72	F	None	Intertrochanteric	C	None	Union	71 days	115 days
28	May 1914	60	F	None	Intertrochanteric	C	None	Union	71 days	115 days
29	Dec 1913	60	F	None	Intertrochanteric	C	None	Union	71 days	115 days
30	Feb 1915	60	F	None	Intertrochanteric	C	None	Union	71 days	115 days
31	Oct 1909	60	F	Housewife	Subcapital	D	Ether	Union	71 days	115 days
32	Mar 1913	40	M	Housewife	Intertrochanteric	D	Ether	Union	71 days	115 days
33	Mar 1913	60	M	Housewife	Intertrochanteric	D	Ether	Union	71 days	115 days
34	June 1914	70	M	Housewife	Intertrochanteric	D	Ether	Union	71 days	115 days
35	Sept 1911	60	F	Housewife	Intertrochanteric	D	Ether	Union	71 days	115 days
36	Nov 1915	71	M	Farmer	Intertrochanteric	D	Ether	Union	71 days	115 days

OLD FRACTURES

Number	Age of Fracture	Age	Sex	Occupation	Position of Fracture	Position	Anesthetic	Immediate Result	Days in bed	Period of complete Disability
37	1 1/2 years	61	F	Housekeeper	Subcapital	A	Ether	Union	71 days	70 days
38	1 year	45	M	Blacksmith	Subcapital	B	Ether	Union	71 days	70 days
39	1 year	41	M	Carpenter	Intertrochanteric	B	Ether	Union	71 days	70 days
40	2 1/2 years	42	F	Stockbreeder	Subcapital	B	Ether	Union	71 days	70 days
41	18 months	41	M	Laborer	Intertrochanteric	B	Ether	Union	71 days	70 days
42	10 months	41	M	Driver	Intertrochanteric	B	Ether	Union	71 days	70 days
43	8 months	40	M	Farmer	Subcapital	B	Ether	Union	71 days	70 days

The period of complete disability means the period in which the patient is unable to get up without assistance from another person, and does not mean the time in which the patient is unable to get up without assistance from another person. The period of complete disability is the time in which the patient is unable to get up without assistance from another person.

traction cord is attached to the outer handle only and in this way the pull of the weight rotates the femur inward in which direction it is assisted by a pad under the trochanter. The patient is put on a Gatch bed with the leg piece made horizontal and the foot of the bed is kept elevated so that the upper portion of the body makes counterextension even when the patient sits up in bed.

Class E Nailing the fragments. In one case of recent fracture we did an open operation, exposing the fracture and fixing the

fragments by means of a nail driven through the trochanter. In a second case a long drill was inserted through a small wound over the trochanter and after the usual manipulations had been made was driven through the reduced fragments into the head of the bone.

Class F Loose fixation by tying out the knees to a spreader attached to the bed rail.

The patient is put on a Gatch bed in a sitting position.

The spreader is made from a 2x4x6 dressed board about 6 feet in length with a hole at each end. These holes 1 inch in diameter are arranged in pairs about 8 inches apart. Each set begins 2 inches from the outer edge of the spreader.

RECENT FRACTURES

Extent of Permanent Disability due to Fracture	Percentage of Former Walkers Earned after Recovery	Ultimate Result, December, 1925	Complication or Handicap at Time of Injury	Number
stiffness of hip	100	Died 1913	None	1
measured shortening	Not affected	Living well and active	None	2
measured shortening	75	Died 1913	Symphysis arteriosclerosis	3
measured shortening	25	Lost after discharge from hospital	Alcoholism	4
measured shortening	100	Lived 1913, pneumonia	None	5
measured shortening	Not affected	Well and active	Chronic nephritis	6
measured shortening	Not affected	Lived 1913	Colic fracture	7
short limited motion	10	Worn rubber heel for shortening	Fracture clavicle and ribs	8
measured shortening	100	Lost after discharge from hospital	None	9
measured shortening	100	Lost after discharge from hospital	None	10
measured shortening	100	Well and active	None	11
measured shortening	100	Well and active	None	12
measured shortening	100	Well and active	None	13
measured shortening	100	Well and active	None	14
measured shortening	100	Well and active	None	15
measured shortening	100	Well and active	None	16
measured shortening	100	Well and active	None	17
measured shortening	100	Well and active	None	18
measured shortening	100	Well and active	None	19
measured shortening	100	Well and active	None	20
measured shortening	100	Well and active	None	21
measured shortening	100	Well and active	None	22
measured shortening	100	Well and active	None	23
measured shortening	100	Well and active	None	24
measured shortening	100	Well and active	None	25
measured shortening	100	Well and active	None	26
measured shortening	100	Well and active	None	27
measured shortening	100	Well and active	None	28
measured shortening	100	Well and active	None	29
measured shortening	100	Well and active	None	30
measured shortening	100	Well and active	None	31
measured shortening	100	Well and active	None	32
measured shortening	100	Well and active	None	33
measured shortening	100	Well and active	None	34
measured shortening	100	Well and active	None	35
measured shortening	100	Well and active	None	36
measured shortening	100	Well and active	None	37
measured shortening	100	Well and active	None	38
measured shortening	100	Well and active	None	39
measured shortening	100	Well and active	None	40
measured shortening	100	Well and active	None	41
measured shortening	100	Well and active	None	42
measured shortening	100	Well and active	None	43
measured shortening	100	Well and active	None	44
measured shortening	100	Well and active	None	45
measured shortening	100	Well and active	None	46
measured shortening	100	Well and active	None	47
measured shortening	100	Well and active	None	48
measured shortening	100	Well and active	None	49
measured shortening	100	Well and active	None	50
measured shortening	100	Well and active	None	51
measured shortening	100	Well and active	None	52
measured shortening	100	Well and active	None	53
measured shortening	100	Well and active	None	54
measured shortening	100	Well and active	None	55
measured shortening	100	Well and active	None	56
measured shortening	100	Well and active	None	57
measured shortening	100	Well and active	None	58
measured shortening	100	Well and active	None	59
measured shortening	100	Well and active	None	60
measured shortening	100	Well and active	None	61
measured shortening	100	Well and active	None	62
measured shortening	100	Well and active	None	63
measured shortening	100	Well and active	None	64
measured shortening	100	Well and active	None	65
measured shortening	100	Well and active	None	66
measured shortening	100	Well and active	None	67
measured shortening	100	Well and active	None	68
measured shortening	100	Well and active	None	69
measured shortening	100	Well and active	None	70
measured shortening	100	Well and active	None	71
measured shortening	100	Well and active	None	72
measured shortening	100	Well and active	None	73
measured shortening	100	Well and active	None	74
measured shortening	100	Well and active	None	75
measured shortening	100	Well and active	None	76
measured shortening	100	Well and active	None	77
measured shortening	100	Well and active	None	78
measured shortening	100	Well and active	None	79
measured shortening	100	Well and active	None	80
measured shortening	100	Well and active	None	81
measured shortening	100	Well and active	None	82
measured shortening	100	Well and active	None	83
measured shortening	100	Well and active	None	84
measured shortening	100	Well and active	None	85
measured shortening	100	Well and active	None	86
measured shortening	100	Well and active	None	87
measured shortening	100	Well and active	None	88
measured shortening	100	Well and active	None	89
measured shortening	100	Well and active	None	90
measured shortening	100	Well and active	None	91
measured shortening	100	Well and active	None	92
measured shortening	100	Well and active	None	93
measured shortening	100	Well and active	None	94
measured shortening	100	Well and active	None	95
measured shortening	100	Well and active	None	96
measured shortening	100	Well and active	None	97
measured shortening	100	Well and active	None	98
measured shortening	100	Well and active	None	99
measured shortening	100	Well and active	None	100

OLD FRACTURES

Extent of Permanent Disability due to Fracture	Percentage of Former Walkers Earned after Recovery	Ultimate Result, December, 1925	Operation	Number
shortening of hip	100	Walks on crutches and high shoes, nearly helpless	Head of bone excised	17
shortening of hip	100	Walks easily, in blacksmith to circus	Subtrochanteric osteotomy	18
shortening of hip	100	1913, 3 years after operation at work	Freeshing and nailin fragments	19
shortening of hip	100	1913, 3 years died of intestinal obstruction	Subtrochanteric osteotomy	20
shortening of hip	100	1913, died embolism after and fracture	Freeshing fragments and animal bone peg	21
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments tie out	22
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	23
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	24
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	25
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	26
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	27
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	28
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	29
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	30
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	31
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	32
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	33
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	34
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	35
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shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	37
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	38
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	39
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	40
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	41
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	42
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	43
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	44
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	45
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	46
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	47
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shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	51
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shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	59
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shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	61
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shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	67
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shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	69
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shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	91
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	92
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	93
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	94
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	95
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	96
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	97
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	98
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	99
shortening of hip	100	1913, lost on heel. At same work	Freeshing fragments autogenous bone peg	100

ting position with a pillow behind the sacrum and the shoulders. The middle section of the bed is lifted so that the knees and hips are flexed to about 30° and the foot section is raised so that it is nearly horizontal. A soft rope attached to an overhead beam, allows the patient to move about by grasping it in both hands.

A covered felt pad is fastened by adhesive plaster under the trochanter of the fractured side. The sound leg is abducted fully and is made fast to one side of a spreader by a roll of gauze folded to make a soft bandage, which is first wrapped around the thigh above the

condyles, just tight enough to avoid constriction. The thigh of the injured side is now rotated in and abducted as far as possible, and is then tied out to the other end of the spreader. The spreader is next attached to the bed rail by straps or bandages. The foot of the bed is elevated, and the pillows are removed from behind the sacrum and the shoulders. As the weight of the trunk pulls away from the tied out thighs, traction is made which gradually overcomes the shortening, and as the adductor muscles tire, the abduction may be increased until finally after a few days both limbs are fully abducted.

CASES NOT TREATED

Number	Date of Injury	Age	Sex	Occupation	Position of Fracture	Extent of Permeant Displacement Due to Fracture	1 st male Result December 1915	Reason for Non-treatment
45	June 1905	34	F	Milliner	Subcapital	Died 4 days	Died 4 days In utero tremors	Delirium tremens
45	Sept 1905	53	F	None	None	Complete	Living gets about in wheel chair	Obesity dyspnoea, cramps Delirium tremens
46	Sept 1905	59	M	Merchant	None	Died 8 days	Died 1 day pulmonary embolism	
47	Dec 1909	75	F	None	Intertrochanteric	Able to walk on crutches	Lost after discharged from hospital	Feebleness Kidney insufficiency Resilience
48	July 1910	74	F	None	Subcapital	None	Lost after discharged from hospital 4th day	Restlessness, feeble heart Loss of control of bladder
49	Aug 1910	69	F	None	Intertrochanteric	Died 25 days	Dead—Edema of limbs	
50	Dec 1911	64	F	Housewife	Impacted Intertrochanteric	Died 20 days	Dead—Pneumonia	Bronchitis, failing heart
51	Old fract	35	F	Housewife	Impacted subcapital	Walked with a crutch	Unchanged	Refused operation
51	Jan 1914	88	M	None	Intertrochanteric	Complete	Living helpless	Chronic nephritis, apoplexy senile dementia
52	Oct 1914	50	F	None	None	Died 3 days	Died 3 days shock	Shock fracture humerus and clavicle Refused treatment
53	Old fract	35	F	Coat Maker	Highly united Intertrochanteric	Paean and limp at discharge	Unchanged	Refused treatment
53	Sept. 1915	75	F	None	None	Died 10 days	Died falling heart	Feebleness, emaciation

If the patient's general condition will permit the reduction is done under general anesthesia and the limbs tied out in complete abduction at once.

By moving the various sections of the Gatch bed the position of the patient may be changed without damage to the fracture and in this way the danger of hypostatic congestion be avoided. The slight movement of the fragments permitted seems to stimulate new-bone formation.

Old fracture of the neck of the femur requires treatment on account of non union or because deformity interferes with locomotion. For non union the head may be excised and the neck fragment or trochanter placed in the acetabulum or the ends of the fragments may be freshened and put in apposition for bony union. Direct fixation by means of a nail, an absorbable peg or an autogenous bone graft may be used to secure approximation and to stimulate bone formation.

When the fracture has united with deformity, subtrochanteric osteotomy is usually done. For the common deformity, adduction with outward rotation a wedge shaped piece of bone is removed from the outer and forward portion of the femur just below the trochanter and the bone is bent outward into abduction of about 20° and twisted as far inward as is possible without making a complete fracture. Overcorrection of the

adduction is the important object of the operation.

Twelve patients in this series were not treated. Two young women declined operation for the relief of deformity following old fracture. One woman aged 74 was taken home by her relatives on the eighth day, after an unfavorable prognosis had been given. This patient as well as another woman who left the hospital unimproved ten weeks after the injury, cannot be traced. Two patients are known to be alive, one a man of 88 and the other a woman of 90, one year and seven years after the injury.

All the usual contra indications to elective operation apply in determining whether or not a patient should be treated for a fracture of the neck of the femur. Certain particular conditions have been noted in studying the fatal cases.

1. **Circulatory.** The presence of dilatation of the heart, intermittent or irregular pulse, and extremes of blood pressure are reasons for non interference.

2. **Pulmonary.** Congestion of the lungs from any cause is a positive contra indication to anesthesia and firm fixation dressing.

3. **Renal.** Most patients with a fractured neck of the femur have some kidney insufficiency. The phthalein test will indicate the vigor of the kidneys and be a guide for the inauguration of treatment. Uremia has a

prominent place in causes of death in this series

4. Nervous Lack of control of bladder and rectum is probably part of a general neurological breakdown Restlessness, irritability, and delirium may be uræmic manifestations, or signs of alcohol and drug habits If persistent these conditions indicate a fatal outcome, and the patient should not be treated Unconsciousness has the same significance

The fifty-five cases of fracture of the neck of the femur here reported have been observed during the past eight years Seven patients cannot be traced Of the remainder 17 are now dead and four are helpless, either on crutches or in wheelchairs as a result of the fracture There are 46 recent and nine old fractures in the series Thirty-six recent cases were treated and 10 were not Of these 36 cases 4 patients died during the treatment, 13 were completely cured, 8 partially cured In 3 cases sufficient time has not passed since the fracture to allow an estimate to be made One patient is unimproved, 1 patient was seriously incapac-

itated by pain until her death six months after she left the hospital Six patients cannot be traced all of whom left the hospital in good condition, apparently cured

Of the 4 fatal cases, one patient developed uræmic symptoms, restlessness, and irritability, with occasional short periods of unconsciousness twelve days after the injury and died on the fifty-eighth day. A second patient died three days after fixation. In this case the examination of the urine before anaesthesia did not indicate a kidney insufficiency. The patient was vigorous in appearance, but she was unable to control the passage of urine and faeces, almost constantly soiling the bed The occurrence of this condition seems to indicate a fatal outcome It was also present in three of the fatal untreated cases The third patient died on the twenty-ninth day, after a stormy illness She was almost maniacal as a result of the use of alcohol and narcotics and finally died in uræmia following 2 days of convulsions The fourth patient died of œdema of the lungs 4 days after fixation.

THE INDUCTION OF LABOR IN NORMAL PELVES AT TERM¹

By CHARLES B. REED, M.D., F.A.C.S., CHICAGO

THE physiological duration of human pregnancy is as yet known only approximately, and the factors that determine the onset of labor are even more obscure. Nevertheless, we do know that while gestation may vary normally from 240 to 330 days, yet the child is fully mature in 275 days of accurately observed time.²

Von Winckel also shows that the continued growth of the child *in utero* after maturity brings with it an increasing danger of morbidity and fatality both to the child and to the hostess and by operative complications greatly intensifies the obstetrical problem.

Thus the time for the beginning of labor is by no means an indifferent matter, nor is it an affair that should be left altogether to accident or to the uncertainty of chance or physical idiosyncrasy. We surely should give to the human family the amount of attention and care the horticulturist bestows upon his apples. The apple is picked at maturity—why not the child?

Is it not possible in the conduct of labor to replace obscurity and uncertainty by clarity, conviction, and method both in its beginning and in its end, to replace the "watchful waiting" of the midwife by the wise control of the scientist, in a word put obstetrics where it belongs in the domain of clean surgery?

During the past year the writer has been seeking, at Wesley Memorial Hospital, to simplify and regulate the course of labor along the line of a high surgical conservatism. The primary question is, Can we assure ourselves that the child is mature and, given a mature child, shall we determine the onset of labor?

The writer believes we can and should do these things and herewith presents some preliminary observations for consideration and record.

The estimation of the child's maturity

¹ Von Winckel. Duration of pregnancy. Deutsch Klin 1914.

has been a most interesting study, for babes may be mature and show great differences in size and weight. For this reason it is necessary to strike an average and take advantage of the generous latitude which Nature allows in all her processes. We, therefore, assume that a mature child is 50 cm long and weighs between five and eight pounds; for we fully accept Von Winckel's dictum that a child of more than eight pounds is a post mature child in 70 per cent of the cases. Undoubtedly, to base any procedure upon such an assumption demands that judgment be assisted by a keen intuition and corrected by a constantly growing experience. Nevertheless, the results have been highly satisfactory. In other words, while the method does not possess an astronomical accuracy, yet, in practice, it works.

In addition to the routine measurements of the pelvis, we obtain our estimate of the child's size, first by its length according to Ahlfeld's rule and then its comparative head size by Mueller's method of crowding the head into the pelvis. In our series of cases the length of the child rarely varied more than 2 cm from the actual post-partum findings and usually was as close as 1 cm or less. The variation also was safely below rather than above the actual figures.

Thus Ahlfeld's rule which hitherto has possessed merely a remote academic interest, becomes practically important. The rule is simple. In vertex cases measurements are made with the pelvimeter from the upper border of the symphysis to the breech of the child, the result is doubled and 2 cm subtracted for the thickness of the abdominal walls. The result is the length of the child. Additional information may be obtained in special cases through a comparison of the head of the child with the maternal pelvis by the Mueller maneuver under anesthesia. Consideration of the cephalic index of the parents also has a certain value.

Our figures are again corrected by the

history of the case, the last menstruation and the day of quickening. If the patient is intelligent, both of these facts are of great value when considered in relation to the anatomical findings. We accept seventeen weeks from conception as the approximate date of quickening and usually count twenty-two weeks from this day as the culmination of the pregnancy. The calculation is not absolute, of course, and sometimes a week more is allowed depending on the parity of the mother and her degree of intelligence. If the history and the anatomical findings are harmonious the day for the labor is definitely appointed.

The next step is to have the labor come on at the time set. The work may be done in any aseptic environment, but the hospital is preferable. The patient receives attention to the bowels the night before and in the morning is given careful obstetric preparation of external genitalia. Then under strictest asepsis a Voorhees bag is introduced without rupture of membranes. Brodhead's report of 139 cases in 1912, is pioneer work in this field and has not received the attention it deserves.

Our technique is as follows:

Assemble and sterilize by boiling 20 minutes, a Voorhees bag No. 4, a Simon speculum or vaginal retractor, a pair of long Pean forceps, 2 pairs vulsellum forceps, 1 dressing forceps, 2 pairs compression forceps, a Goodell dilator, 1 tenaculum forceps, a hand bulb syringe with glass tubes and rubber connections for the bag.

The patient, prepared as for delivery, is placed upon the table in exaggerated lithotomy position. Stirrups will serve.

The vagina is retracted, a smear made from the cervix, and the mucous membrane wiped clean with pledgets of gauze on forceps.

Anæsthesia is only occasionally necessary even in primiparæ.

Before using, the apparatus must be tested by forcibly filling the bag with sterile solution.

One lip of the cervix is seized by the vulsellum forceps and brought down. Usually even in primiparæ, the os is sufficiently patulous to admit the bag, if not dilate

The bag is emptied of residual air and fluid and the flat end pulled out. It is now rolled up into a compact mass like a cigarette and seized with Pean forceps, so that the tips extend just to the largest diameter of the rolled bag. Anoint with sterile glycerine, turn the curve of the forceps toward the patient's left leg and introduce. As the bag enters, turn the mass to the operator's left—a quarter turn—so that when the operation is completed the forceps curve looks upward. Release lock on forceps. Connect tube with syringe and force sterile solution slowly into the bag. Pean forceps may be removed as bag fills. Remove vulsellum. Tie tube with tape when bag is full, disconnect syringe. Put sterile pad on either side of tube.

If pains do not start within an hour, or if compression is desired as in placenta prævia, or a more rapid dilatation, then a weight of one or two pounds is attached by a tape to the protruding tube and passed over the foot of the bed. Usually in from five minutes to half an hour contractions begin and labor has been inaugurated just as one would start the pendulum of a clock.

In a variable period, rarely more than four hours—three hours and twenty minutes was the average in our series—the bag is expelled by strong pains, the dilatation is practically complete, the head follows the bag down, the membranes rupture, and the second stage begins. From now on the case is managed according to general obstetrical principles. If the pains are weak and shallow, pituitrin may be indicated, if strong and regular, morphine and scopolamine or gas or chloroform may be added. The tedious, exhausting, and painful first stage has been materially shortened and definitely controlled. The bag acts as a dynamic stimulant to the contractions, as well as a mechanical aid to cervical dilatation, and it preserves the membranes from injurious pressure until physiological rupture occurs.

Theoretically there are two objections to this procedure which were ever before us: The possibility of infection was the one most dreaded. Hence for months we made smears from the vagina and cervix of all

cases. Naturally we found every variety of pythogenic organism, including the streptococcus, staphylococcus, and gonococcus. The bag was introduced nevertheless and none of these women had temperature post-partum. It is our belief that the shortening of the labor process and the preservation of maternal vitality maintains the maternal immunity and prevents the infection that would easily and probably follow a more prolonged labor whether induced or uninduced. If this should prove to be true, we may ultimately look back on the policy of "watchful waiting" as an evasion of responsibility that is unjustifiable.

The second danger is the possibility of prematurity. This happened once in our series. The case was not supervised and an interne, who had made enough measurements for educational purposes and was supposed to be reliable, measured the uterus instead of the foetus and the result was a seven months' child. This danger is practically nil when proper care is used.

It has been urged as an incidental objection to the bag that it frequently changes the position of the presenting part. We have found this to occur demonstrably only two or three times and not unfavorably. In fact in several instances the attempt has been made to secure such a change, but the Voorhes bag with its flat top does not lend itself readily to this object.

The results obtained by the use of the bag in a series of one hundred consecutive cases are herewith submitted.

Primipara, 35 multipara, 65 average duration of labor seven hours forty five minutes shortest labor fifty five minutes longest labor thirty hours in 2 primipara with a cartilaginous cervix and twenty eight hours in a multipara with much cicatricial tissue in the cervix.

The bag broke, during or shortly after insertion, six times and was reinstated three times. The average time for the expulsion of the bag was three hours twenty minutes. The membranes were ruptured by the introduction of the bag twice.

There were two maternal deaths, one from placenta previa complicated with myocarditis and one from pneumonia eight days after labor. Neither death can be charged to the bag.

The average weight of the babies was 7 7 pounds, the smallest child weighing 5 pounds and the heaviest 10 pounds five ounces.

Seven babies died, one, the child of a primipara after a spontaneous labor of sixteen and a half hours, was born in asphyxia pallida, was revived with difficulty, and died eight hours later. The second, the child of a multipara, was born blue after a spontaneous labor of one hour and thirty minutes, was revived, and died suddenly thirty-six hours later. The third and fourth children died from compression of the cord by the head at the outlet, one of these being also syphilitic. The fifth and sixth were delivered with forceps from primipara with contracted pelvis, one in the occipitoposterior position was stillborn, the other lived two hours. The seventh child was delivered prematurely. This is the only case attributable to the method and we believe it was wholly unnecessary.

There were three cases of version and extraction, for placenta previa, transverse presentation, and prolapsed cord. There were four cases of breech presentations, two of placenta previa, one of prolapsed arm, one of mitral stenosis, one of mitral insufficiency. There were 17 cases of lacerations of the perineum, of 2 degrees or less, and episiotomy. One case presented grave albuminuria.

Forceps were used in 23 cases as follows: 4 in traction in 2, low forceps for occipitoposterior position of head 9, deep transverse arrest, 8, insufficiency of the powers, 4. Four of these might be called *schlechte unge*.

Seven cases had post partum temperature. Case 1 had pulmonary tuberculosis with evening rise of temperature. Case 2 had pneumonia. Case 3 had a temperature due to mastitis which went to 102° lasted twenty hours on the third day, and disappeared under the ice pack. Case 4 had a temperature on the ninth day which went as high as 105° and was probably due to an old pelvic infection or to the nurse who had a suppurating injury of foot which she did not report until too late. This temperature ran two weeks and developed a mass in the pelvis which ultimately absorbed. Case 5 had a temperature due to the prolonged labor—30 hours—which went to 102° on the second day and lasted for three days. There were no pelvic symptoms. Case 6 had a temperature due to colitis. It was 104° on the fourth day and lasted 24 hours. There were no pelvic symptoms except the diarrhoea. Case 7 suffered a temperature due to nervousness and after pain. On the second day the temperature was 102° and remained so for twelve hours. There was no pelvic tenderness and the temperature subsided under bromides.

In no case except Case 4 was there tenderness over or beside the uterus, neither foul discharge or subinvolution. None of these cases therefore, unless it be Case 5, can be attributed to the bag.

In only one case was post partum catheterization necessary as compared with former methods of delivery.

The writer ventures to call attention

particularly to the number of forceps cases, which is far higher than the number reported from most clinics. It is quite probable that some of the occipitoposterior positions would have rotated and that a certain number of the arrested heads would have delivered if time enough had been allowed.

But it was a deliberate part of this investigation to shorten the labor wherever it could be done without increasing the danger of injury to the mother or child. It was thought, and we now believe wisely, that by preserving the maternal vitality and immunity the advantage would more than counterbalance the slight increase of danger involved in the interference. It is more than probable that in skilful hands the courageous use of forceps is safer for mother and child than a timid reliance on the aimless powers of Nature with the possibility ever present of an ultimate employment of forceps. At the same time it is not felt that the resort to instruments has been in any degree hasty, for before external aid is decided upon our routine requires that we ascertain the position of the head, that we learn the character of the pains and know that dilatation is complete. Then, if necessary, pituitrin is used to strengthen the pains and a time limit is allowed for molding and delivery of the head, which approximates one and one half and two and one half hours in multiparæ and primiparæ respectively.

The absence of infection in the cases where pathogenic organisms were present is extremely interesting and significant since it may ultimately prove that bacteria are a relatively negligible factor in short labors. Furthermore as the work has gone on we have all been more and more impressed by the freedom from post partum exhaustion

and nervous prostration in these cases and their quick convalescence. This can hardly be unexpected since a process that shortens labor anywhere from four to twelve hours must necessarily result in a tremendous saving of energy and vitality. Our observations thus far lead us to believe that the bag can be used freely and harmlessly both in primiparæ and multiparæ and in normal as well as pathological cases. It removes and overcomes the principal obstacle in a majority of labors—the undilated cervix—and leaves us only the bony pelvis as an obstruction and this too in a patient whose strength is as yet unreduced.

The only exceptions we are inclined to consider at present are the multiparæ with much cicatricial tissue in the cervix and primiparæ where the same part is thick and hard. These are difficult cases however under any circumstances and it is probable that our experience in future will show that such women have far more satisfactory labors *with* the bag than without it. Moreover these cases are close to pathology and should be considered separately—in the class with contracted pelves.

The highest advantage of our procedure lies in the fact that the course of labor is entirely under the control of the obstetrician from start to finish. There is no timidity, indolence, or dubiety. The day is appointed, the cervix is dilated slowly or quickly, the contractions are strengthened or weakened, the pelvis is enlarged or let alone, complications are boldly met or foreseen and avoided, the labor is hastened or prolonged; the pain is permitted, diminished, or abolished according to the judgment of the operator. The process works in strict harmony with the principles of modern science.

THE PHYSIOLOGICAL METHOD OF TENDON TRANSPLANTATION¹

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II OPERATIVE TECHNIQUE

THE physiological method of tendon transplantation has as its basic principle the correlation of every step of the operation as well as the indications therefor and the after treatment with the normal mechanics of tendon motion. It takes cognizance not only of the course and insertion of the tendon as given in the anatomical textbooks but of many other less known but equally important facts such as the blood supply of the tendon, its fascial relations at various levels, its length, range of motion, its action, not merely in the normal situation but when the point of insertion has been altered, the exact location and inner architecture of its sheath, the character and line of insertion of the mesotenon and the nerve associated with the tendon. All these details cannot, of course be given in this paper. For them I must refer the reader to the monograph "*Die physiologische Sehnen-er-pflanzung*" by Biesalski and Mayer.²

A physiological tendon operation must conform not only with the general surgical principles of absolute asepsis, minimal hemorrhage and minimal traumatism but also with the following demands:

1. It must wherever possible restore the normal relationship between the tendon and the sheath.

2. The course of the tendon from its original site to that of the paralyzed tendon must run through tissue adapted to the gliding of the tendon. Injury to the peroneum or the crude boring of a hole through fascia or interosseous membrane is inconsistent with this demand.

3. The normal insertion of the tendon must be imitated wherever possible by implanting the living transplanted tendon directly into bone or cartilage, preferably at the insertion of the paralyzed tendon.

4. The normal tension of the transplanted

tendon must be re-established and the physiological length of the transplanted muscle thus maintained.

5. The line of traction of the transplanted tendon must be such as to enable it effectively to do the work of the paralyzed tendon.

DESCRIPTION OF THREE TYPICAL PHYSIOLOGICAL TENDON TRANSPLANTATIONS

1. TRANSPLANTATION OF THE EXTENSOR PROPRIUS HALLUCIS FOR THE TIBIALIS ANTEICUS

The operation is indicated only in cases of comparatively slight paralytic valgus, for the extensor proprius hallucis even on the assumption of its functional hypertrophy subsequent to the operation is not strong enough to replace the tibialis anticus.

1. *The first skin incision* 4 cm. long, bowed with the convexity toward the sole of the foot is made over the insertion of the tibialis anticus.

2. *Preparation of the implantation site for the extensor hallucis.* The tendon of the tibialis anticus at its insertion is slit longitudinally for 3 to 4 cm., and the bone or cartilage of the internal cuneiform is grooved for the reception of the extensor tendon (see Fig. 6, 1).

3. *The incision over the extensor proprius hallucis tendon.* This runs in the line of the tendon from a point 3 cm. above the tip of the internal malleolus to the middle of the first metatarsal bone. The reason for this long incision is evident, when the sheath of the tendon has been opened. Then it is seen that the mesotenon attaching the tendon to the floor of the sheath is too well developed to allow withdrawing the tendon from the sheath through a small supramalleolar incision.

It is well, however, not to expose the tendon unnecessarily at this stage of the operation, but to leave it *in situ*, until all has been made

¹ Published by Springer, Berlin.

² The first article in this series of papers on Tendon Transplantation appeared in the February 1916 issue, p. 153.

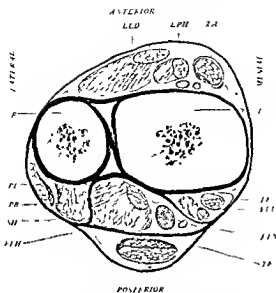


Fig 1 Cross section, drawn from microscopic section, (semidiagrammatic) of the calf 5 cm above the tip of the internal malleolus. The section lies below the proximal pole of the tibialis anticus above the sheaths of the extensor proprius hallucis and extensor longus digitorum. Note that the three anterior muscles lie in the same fascial compartment. *ELD*, Extensor longus digitorum; *EPH*, extensor proprius hallucis; *TA*, tibialis anticus and sheath; *T*, tibia; *TP*, tibialis posticus and sheath; *FLD*, flexor longus digitorum; *PTN*, posterior tibial nerve; *TF*, deep transverse fascia; *F*, fibula; *PL*, peroneus longus; *PB*, peroneus brevis; *SIP*, septum intermusculare posterius; *FHH*, flexor longus hallucis.

ready for transferring it into the sheath of the tibialis anticus.

4. This transfer requires an accurate knowledge of the fascial relations between the two tendons. Figure 1, a diagrammatic cross section through the calf about 5 cm above the tip of the malleolus shows the three anterior muscles of the calf lying within the same fascial compartment. Figure 2, about three centimeters distal to the first, shows the extensor proprius hallucis and the tibialis anticus divided from one another by a fascial septum derived from the fascia cruris. To run the extensor hallucis through this fascial septum would not be physiological. On the other hand, freeing the extensor hallucis to the level of the first cross section where both muscles lie within the same fascial compartment would involve sacrificing many muscle-tibers and important blood vessels, since the origin of the extensor hallucis extends down-

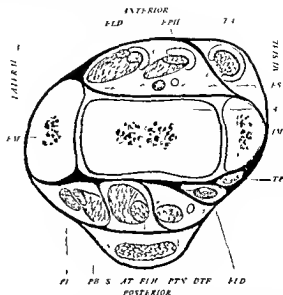


Fig 2 Cross section, drawn from microscopic section, (semidiagrammatic) of the calf 3 cm distal to the section shown in Fig 1. Here the sheath of the three anterior tendons are present. Note that the tibialis anticus is separated from the other extensors by a fascial septum. *ELD*, Extensor longus digitorum; *EPH*, extensor proprius hallucis; *TA*, tibialis anticus; *TS*, fascial septum; *A*, astragalus; *IM*, internal malleolus; *TP*, tibialis posticus; *FLD*, flexor longus digitorum; *PTN*, posterior tibial nerve; *DTF*, deep transverse fascia; *FLD*, flexor longus digitorum.

ward almost to the level of the malleoli. Fortunately, nature has indicated a suitable path. At one point, usually about 2 cm above the malleolus, the septum separating the tendons is so thin as to be transparent. This is the site of election (see Fig 3). Here the operator can draw the extensor tendon into the sheath of the tibialis anticus, confident in the knowledge that serious post-operative adhesions will not result. Since this point lies slightly above the upper pole of the extensor hallucis sheath, the fascia over the extensor must be incised for 2 to 3 cm proximal to the sheath. The mesial fascial edge is grasped with the clamp shown in Fig 4 and raised until the operator sees this thin portion of the septum. Here a small incision is made directly into the tibialis sheath. An eye probe is passed through this incision in the line of the tibialis tendon, made to puncture the lower end of the sheath,



Dissection showing the fascial septum separating the tibialis anticus from the extensor proprius hallucis. The sheaths have been opened, the tibialis anticus is lifted out of the sheath, the extensor proprius is drawn to one side. The preparation demonstrates the thin portion of the septum where the transfer tendon is least liable to cause dangerous adhesions. Labels: *T.A.*, tibialis anticus; *P.*, plica; *T.*, thin of the fascial septum; *FPH.*, extensor proprius drawn to one side.

appear over the insertion of the tendon. The sheath of the extensor hallucis is then slit open its entire length. The tendon is divided near the middle of the tarsal bone, its end grasped with the clamp and the mesotenon divided to the tendon until the operator reaches the innermost muscle-fibers. The vessels of the mesotenon are thus sacrificed, but a vessel which runs through the lower muscle-fibers can always be spared. The tendon end is threaded with chromic by the stitch shown in Fig 5, the free ends of the suture are passed into the eye of the needle and the tendon thus readily drawn through the sheath of the tibialis anticus. The drawing of the tibialis anticus tendon through the sheath as first advocated by Biesalski is needless trauma and is unnecessary, the sheath does not closely invest the tendon, but is large enough to accommodate the tendon.

Fixation of the tendon. Here the knowledge of the laws of tendon tension is important, since otherwise the operator is liable to sew the tendon under too great a tension and thus throw an unnecessary strain on the transplanted muscle. It may be remembered that in outlining the physiology of tendons I showed that when the tendon is relaxed under narcosis and its origin



Fig 4 The author's tendon clamp

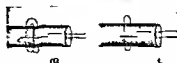


Fig 5 The fixation suture. *A*, single stitch; *B*, double stitch. The sutures combine great mechanical stability with comparatively little trauma to the tendon.

and insertion are approximated, the tendon itself, as well as the muscle-fibers, have a zero tension. Therefore, to give the transplanted tendon the exact physiological tension, one must merely approximate the origin of the muscle and its new point of insertion (in this instance, by holding the foot supinated and flexed dorsally), draw the tendon downward until it runs in a straight line, and suture it under just sufficient tension to maintain this desired course. With a little experience the operator knows beforehand just how long the tendon must be to reach its new point of insertion and the chromic gut suture, inserted to draw the tendon through the sheath, can thus be used as the fixation suture.

The implantation site has already been prepared (see second step of the operation) by slitting the tibialis tendon lengthwise and traumatizing the periosteum of the internal cuneiform. The tendon, threaded by the fixation suture shown in Fig 5, is now fastened securely between the two halves of the tibialis tendon. The sutures are threaded on a stout cervix needle or an instrument resembling a shoemaker's awl, and are passed through bone or cartilage, ligament, and fascia. The fixation must be mechanically fast. When properly executed it can withstand a traction of 20 to 30 pounds.

This mechanical fixation does not, however, meet the physiological demand, for firm though the suture is at the time of the operation, experimental work has shown that such

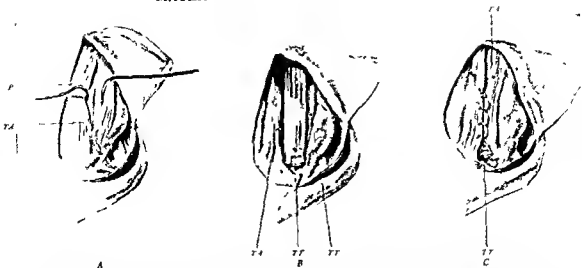


Fig. 6 The fixation of the transplanted tendon. The extensor proprius hallucis is being transplanted to replace the paralyzed tibialis anticus. *A*, (at left) Preparation of the fixation site. The tendon of the tibialis anticus is slit lengthwise and the periosteum of the internal cuneiform traumatised, so as to stimulate bone growth. *B* The tendon of the extensor proprius hallucis threaded with the fixation suture shown in Fig. 5, is fastened securely by several

deep stitches passing through bone, ligament, and fascia. *C*, The tendon of the tibialis anticus is sutured to the extensor tendon thus rendering the mechanical fixation still firmer and assuring a physiological fixation by pressing the extensor tendon against the traumatised periosteum. *P*, Periosteum of the internal cuneiform, *T.A.*, tendon of the tibialis anticus slit longitudinally, *TT*, transplanted tendon.

a suture produces a necrosis of the tendon, and therefore there is a possibility that subsequently the tendon may slip from its moorings. This slipping, however, is prevented by suturing the paralyzed tibialis tendon over the extensor hallucis (Fig. 6). In this way the living tendon-cells of the extensor proprius hallucis above the fixation suture are brought into direct contact with the periosteum and with the tendon of the tibialis anticus (Fig. 7). Thus the fixation is rendered physiological as well as mechanical, for in the healing process, even though the tendon distal to the fixation suture necroses, an intimate union above this point is bound to occur between the tendon and the traumatized periosteum.

7 The distal stump of the extensor tendon is fastened to the adjacent tendon of the extensor longus digitorum the fascia is closed, and thus the normal ligaments of the foot are restored. The skin incisions are closed without drainage.

11. CONVERSION OF THE TIBIALIS ANTICUS INTO AN ABDUCTOR AND PRONATOR

This operation is indicated in cases of para-

lytic or spastic talipes varus, and in some cases of congenital club-foot. It should be performed only when a marked degree of correction is required, for the action of the muscle is so powerful as easily to produce an overcorrection. When slighter grades of varus are present, the extensor proprius hallucis should be used instead of the tibialis anticus. The two operations are so nearly

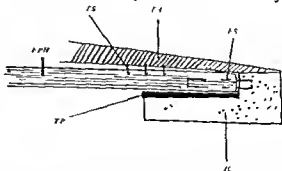


Fig. 7 Diagram illustrating the principle of the physiological tendon fixation. The fixation suture gives the mechanical stability, the adhesion of the tendon to the traumatised periosteum and to the superimposed tibialis tendon gives the physiological security. *TS*, Tendon suture, *T.A.* paralyzed tibialis anticus, *FS* fixation suture, *IC*, internal cuneiform, *TP*, traumatised periosteum, *FPH*, tendon of the extensor proprius hallucis.

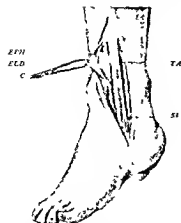


Fig 8 Conversion of the tibialis anticus into an abductor and pronator. The tendon has been laid bare from the proximal pole of its sheath to its insertion, and the fascia cruris drawn lateralward with the clamp exposing the tendons of the two long extensor muscles. These tendons in contradistinction to the tibialis anticus are still enveloped in connective tissue—the paratenon since the upper pole of their sheaths lies distal to that of the tibialis. *EPH*, Extensor proprius hallucis, *ELD* extensor longus digitorum. *C*, clamp retracting the incised fascia cruris. *TA* tibialis anticus. *SV* internal saphenous vein.

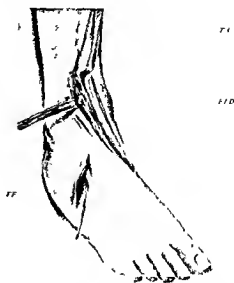


Fig 9 Conversion of the tibialis anticus into an abductor and pronator. The implantation site has been prepared by an incision exposing the insertion of the peroneus tertius; the tendon has been slit longitudinally, and the periosteum of the metatarsal bones traumatized as in Fig 6. The tibialis anticus threaded with the fixation suture has been lifted out of the sheath after carefully dividing its mesotenon. The free ends of the suture are attached to a probe which runs through the common sheath of the extensor longus digitorum and peroneus tertius, and emerges at its lower pole near the insertion of the peroneus tertius. *FF* Flap of skin and fascia. *TA*, tendon of the tibialis anticus, *ELD* tendons of the extensor longus digitorum.

alike that the description of the one suffices.

1. A four-centimeter curved incision is made over the insertion of the peroneus tertius (see Fig 9). Skin, fascia and subcutaneous tissue are retracted to form a flap.

2. The tendon of the peroneus tertius, which in the dissection of 25 cadavers and in all the operations was invariably present, is then slit for several centimeters as in Fig 6A and the metatarsal bones grooved for the reception of the tibialis anticus.

3. An incision is made in the course of the tibialis tendon from the upper pole of its sheath, 3 to 5 cm. above the malleolus, to its insertion (Fig 8). The sheath is opened near its upper pole. Here again the exact knowledge of the sheath, its limits and inner architecture is necessary for the neat execution of the operation.

4. It will be remembered that in describing the first operation attention was called to the fascial relations of the three anterior muscles of the foot—the tendons above the upper pole of the tibialis sheath lie in the same fascial compartment then for several centimeters

the extensor proprius hallucis and the extensor longus digitorum lie in the same fascial compartment separated from the tibialis anticus by a fascial septum. From the level of the malleolus downward there are three such compartments, one for each of the three anterior muscles (Fig 10).¹ The transfer of the tibialis tendon is best made above the fascial septum separating it from the extensors, since in this way danger of adhesions is entirely avoided.

The lateral margin of the divided fascia just proximal to the upper pole of the tibialis sheath is retracted until the extensor longus digitorum is visible (Fig 8). This level lies above the upper pole of the extensor sheath. To enter the sheath the loose connective tissue surrounding the extensor tendons—

¹ The tendons of the extensor longus digitorum and of the peroneus tertius lie in the same compartment.

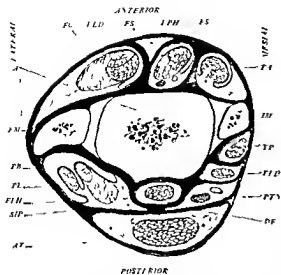


Fig 10 Cross section (semidiagrammatic) of the calf 1 cm proximal to the tip of the malleolus. The sheaths of the three anterior muscles are shown. Note that each tendon lies in its own fascial compartment (see also Figs 1 and 2). *FL* *Fascia cruris*, *FLD* *extensor longus digitorum* and *peroneus tertius*, *FS* *fascial septum*, *EPH* *extensor proprius hallucis*, *T1*, *tibialis anticus*, *IM* *tip of internal malleolus*, *PT* *tibialis posterior*, *FLD* *flexor longus digitorum*, *PTN* *posterior tibial nerve*, *DF* *deep fascia*, *A*, *astragalus*, *EU*, *tip of external malleolus*, *PB* *peroneus brevis*, *PL* *peroneus longus*, *LHF* *flexor longus hallucis*, *SIP* *septum intermusculare posterius*, *AT* *Achilles tendon*.

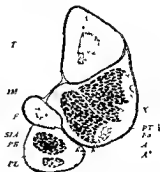


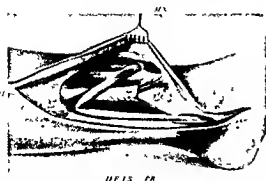
Fig. 11 Diagrammatic cross section of the calf illustrating the fascial plastic for transferring the peroneus longus from its fascial compartment into the anterior fascial compartment. The fascial edge *A* is united by a Lembert suture with the edge *A'*. Its deep surface coated with gliding tissue — the paratenon — is thus exerted to serve as a physiological path for the peroneal tendon. *T*, tibia, *IM*, interosseous membrane, *F*, fibula, *SIA*, septum intermusculare anterius, *PB*, peroneus brevis, *PL*, peroneus longus, *X*, anterior muscular compartment, *PT*, paratenon, *Fa*, fascia, *A*, *A'*, fascial incisions.

be divided as near the bone as possible; otherwise it would not be long enough to reach its new point of insertion. It is then threaded with stout chromic gut as in Fig 6 and freed from its mesatenon until it can run a direct course into the sheath of the extensor digitorum and peroneus tertius.

6 The tendon is drawn through the sheath by means of an eye-probe (Fig. 9) and fastened to the bone and to the peroneus tertius tendon by the technique described in the first operation. Care must be taken that the course of the tendon is straight and that the muscle is not twisted.

III TRANSPLANTATION OF THE PERONEUS LONGUS FOR THE TIBIALIS ANTIQUS

The operation is indicated in cases of spastic or paralytic talipes valgus. This operation possibly better than any other illustrates the advantages of the physiological method of tendon transplantation. The operation as usually performed does not efficiently replace the paralyzed tibialis anticus, for unless the peroneal tendon runs through the sheath of the tibialis tendon a supinating effect is impossible. This fact can readily be demonstrated by experiments on the cadaver as well as by clinical experience. The operator, however, faces a grave difficulty in running



H.F. 12

Fig. 12 The transposition of the peroneus longus for the paralyzed tibialis anticus. The fascial plastic has been executed and the tendon can pursue a physiological course from its fascial compartment to the sheath of the tibialis anticus. The Lembert suture, when properly introduced, does not come in contact with the peroneal tendon, since the suture is covered by the muscular fibers of the peroneus brevis. PL, Tendon of the peroneus longus; MA, musculocutaneous nerve; IF, inverted fascial flap; LS, Lembert suture; PB, peroneus brevis.

the peroneal tendon from its original site to the sheath of the tibialis anticus, for the two muscles are separated throughout their entire length by a well developed fascial wall—the septum intermusculare anterior. To overcome this difficulty, a fascial plastic operation is necessary.

The steps of the operation are as follows:

- 1 Incision over the insertion of the tibialis anticus as in the first operation, and preparation of the plantation site by slitting the tibialis tendon and grooving the internal cuneiform.

- 2 A three centimeter incision near the upper pole of the tibialis sheath enables one to open the sheath and to pass a probe threaded with a guide-suture through it to the insertion of the tendon. The probe is drawn entirely through, leaving the guide-suture in place.

- 3 The third skin incision is made over the peroneus longus tendon from the middle of the calf to the cuboid. This long incision is necessary, for unless the tendon is freed almost to the middle of the calf it cannot be given a proper line of traction. The upper end of the incision curves anteriorly so as to permit the execution of the fascial plastic. The skin and subcutaneous tissues above the malleolus are retracted from the underlying

fascia cruris until not only the peroneal muscles, but also the muscles of the anterior group—the extensors—are visible.

- 4 The fascial plastic. Experimentally we know that the boring of a hole through the fascial septum tends to produce adhesions, whereas it is equally evident that the deep surface of the fascia from the middle of the calf downward is unusually well adapted to the gliding of the tendon, because it is clothed with the elastic paratenon. Therefore instead of ripping a hole through the fascia with the dressing forceps it is carefully incised first over the peroneal compartment, then over the anterior muscular compartment (see Fig. 11). This latter incision is made to outline a flap (Fig. 12) which is inverted so as to expose the paratenon clothing its deep surface, and sutured by a Lembert stitch to the edge of the inverted fascia of the lateral fascial compartment (see Fig. 11). The stitch itself is taken as near as possible to the fibula, so as to bury it in the muscular fibers of the peroneus brevis. By this simple procedure a physiological path for the peroneal tendon is constructed. The fascial incision must be somewhat longer than at first thought seems necessary, because the tendon runs not transversely but slanting from above downward.

- 5 An eye-probe is then passed from the upper pole of the tibialis sheath beneath the fascia cruris and made to appear in the region of the fascial plastic. The upper end of the guide suture lying in the tibialis sheath (second step of the operation) is drawn beneath the fascia by means of the probe. The guide suture thus runs from the fascial plastic beneath the fascia cruris into the tibialis anticus sheath downward through the sheath and out near the insertion of the tibialis tendon. It serves to draw the peroneal tendon along this course.

- 6 The peroneal tendon is now freed by prolonging the fascial incision already made over its upper end, downward until the sheath has been opened, usually 3 to 4 cm above the malleolus, and then along the sheath to the groove in the cuboid where the peroneal tendon passes into the sole of the foot. When the peroneal tendon is divided at this point,

it reaches exactly the desired insertion on the inner border of the foot. It is threaded with the fixation suture, freed from its mesotenon, and by means of the guide suture drawn over the fascial bridge downward through the tibialis sheath. Fixation to the internal cuneiform, as in the first operation.

The fascial incisions are closed wherever possible, not only to restore the normal anatomical relations, but also as far as possible to prevent post-operative hemorrhage.

SUMMARY OF THE PHYSIOLOGICAL TENDON TRANSPLANTATIONS

In these three operations it has been possible to meet all the demands of the physiological method. The physiological principle is, however, applicable even when no tendon sheath is present. Thus, for instance, in the case of the paralyzed quadriceps femoris, a physiological tendon plastic can be performed by running the substituting tendons through the subcutaneous tissues. In some instances the sheath can for a short distance be transplanted with the tendon, e.g., the extensor proprius hallucis can, under some circumstances, be more advantageously transplanted with its sheath than by running it through the sheath of the tibialis anticus.

As a result of my study the following operations can be termed physiological.

These operations are not meant to form a closed system. It is earnestly to be hoped that further experimental and clinical work will enable us to include other operations in this category.

I. FOOT

1. *For talipes valgus* (a) Extensor proprius hallucis through the sheath of the tibialis anticus, or transplanted with the sheath to the inner border of the foot. (b) Peroneus longus through the sheath of the tibialis anticus. The fascial plastic is in this instance necessary. *a* and *b* can be advantageously combined, the peroneal tendon is run through the tibial sheath, the extensor hallucis tendon is transplanted with its sheath. (c) The extensor longus digitorum and the peroneus tertius subcutaneously to the inner border of the foot. In the operation the normal re-

lation between tendon and sheath cannot be restored, but all other demands of the physiological method are met. (d) The flexor longus digitorum through the sheath of the tibialis posticus, inserted into the scaphoid. The flexor digitorum is in its original situation a supinator and an abductor, but transferring its insertion to the scaphoid increases this action and helps to maintain the normal contour of the foot.

2. *For talipes varus* (a) Tibialis anticus through the sheath of the extensor longus digitorum and peroneus tertius to the base of the fifth metatarsal bone. (b) The extensor proprius hallucis through the same sheath to the same insertion. This operation is indicated in milder cases of varus deformity. (c) The flexor longus hallucis through the sheath of the peroneus brevis to the fifth metatarsal. This operation is extremely difficult technically, since the tendon must be freed in the sole of the foot and its attachment to the flexor longus digitorum, present in 95 per cent of the cases, must be severed before the tendon can be transplanted. At one point in its course from its original sheath to the peroneal, the tendon must pass through a fascial septum, the septum intermusculare posterius. To this extent the operation fails to meet the physiological demand but the fatty upper pole of the flexor hallucis sheath can for a short distance be transplanted with the tendon and thus protect it from gross adhesions to the fascia.

3. *For talipes calcaneus* (a) Flexor longus hallucis to the tuberosity of the os calcis. (b) Peroneus longus to tuberosity of the os calcis. *a* and *b* are advantageously performed at the same time. When the talipes calcaneus is combined with marked cavus deformity a preliminary astragalectomy (Whitman) is indicated.

4. *For talipes equinus* (a) Transplantation of the peroneus longus through the tibialis anticus sheath to the internal cuneiform. (b) Transplantation of the peroneus brevis subcutaneously to the base of the fourth metatarsal. *a* and *b* are always performed together.

Other operations for talipes equinus, such as transplanting the tibialis posticus, the

flexor longus digitorum and the flexor longus hallucis prove, after careful cadaver experiments and clinical observation, to be unphysiological

5 *Claw toe* Jones's operation of inserting the long extensor tendon into the head of the metatarsal bone meets all the physiological demands

II KNEE

1 *For paralysis of the quadriceps extensor* (a) Subcutaneous transplantation of the biceps to the patella (b) Subcutaneous transplantation of the sartorius, gracilis or semitendinosus to the tuberosity of the tibia It is well to combine the transplantation of the biceps with one of the muscles of the second group, so as to prevent an outward dislocation of the patella The semimembranosus does not lend itself to transplantation, because it is needed to maintain the stability of the posterior capsule of the knee

III HAND

1 *For paralysis of the extensors* (a) Flexor carpi radialis through the sheath of the extensor carpi radialis longior to the base of the second metacarpal bone (b) Flexor carpi ulnaris subcutaneously to the tendon of the extensor carpi radialis The tendon is too short to reach the bony insertion, but it can be sutured to the extensor tendon sufficiently near the insertion of the latter to give good operative results This operation should never be performed alone, since the extensor carpi ulnaris has little extensor effect except when combined with the extensor carpi radialis

c Flexor sublimis digitorum subcutaneously to the extensor communis digitorum or

through the sheath of the extensor carpi radialis longior and brevior to the base of the second and third metacarpal bones The latter operation is indicated, when extension of the fingers is possible, but extension of the wrist not

2 *For replacing the extensor tendon of a single finger.* Transplantation of the index finger tendon of the extensor communis digitorum

3. *For replacing the flexor tendons of a single finger* Transplantation of the adjacent flexor sublimis digitorum tendon.

IV ELBOW

For paralysis of the biceps Transplantation of the long head of the triceps subcutaneously to the insertion of the biceps

CONCLUSION

In this, the second paper dealing with the physiological method of tendon transplantation I have indicated the practical application of a knowledge of tendon anatomy and physiology to the technique of tendon operations Each step of the operation must accord with the normal mechanics of tendon motion The operations are essentially simple, although their description sounds complicated Their neat execution however, is by no means easy and requires not only good surgical technique but ample practice on the cadaver Unless the surgeon can conscientiously meet these requirements he should not attempt the tendon transplantation

In the third paper I shall report the experimental and clinical results of the physiological method of tendon transplantation

OSTEOCHONDRAL TROPHOPATHY OF THE HIP-JOINT

By ARTHUR T. LEGG, M.D., BOSTON

AT the meeting of the American Orthopedic Association in June, 1909, I reported five cases of what I then differentiated as "an obscure affection of the hip-joint." This paper, preliminary and tentative in character, was intended rather to focus the attention of other surgeons in orthopedic work upon the conditions which I believed had never been described up to that time, than to adequately present a theory of etiology or complete survey of clinical observations and end-results of treatment upon the cases in hand. I endeavored to present suggestions upon cause, course, and occurrence, and hoped to precipitate the report of similar cases from the practice of others.

After presenting these cases, I made a study of the literature which might have any bearing upon this affection and found reported as examples of other diseases of the hip, sporadic cases, which appeared to me as illustrations of a similar condition. These isolated instances were invariably described in conjunction with cases very dissimilar in character as related to already established types of disease and were not sorted into a special group which, through a definite symptomatology, might be accepted as an entity.

Thus as a juvenile form of arthritis deformans a disease very different in all essentials from the one I describe. Dr. Hoffa of Berlin, in his text of 1903 reviewed several cases reported by Maydl and Mueller, to which a traumatic origin was assigned. In the same year, von Brunn under the head of juvenile osteo arthritis deformans considered at length four cases reported by Maydl and Zesas and added to them two cases of his own. Upon the etiological occurrence of a trauma he stated in his conclusions that "trauma does not play as heretofore thought, the single striking rôle, but a form of the sickness is idiopathic." In 1905, Dr. A. H. Freiberg reported as *coxa vara adolescentium* a case which appears to me identical with my own,

but he relates this case and another presented simultaneously to the cases already mentioned.

These early cases have been mainly interesting to me from the discussion of traumatic etiology which they precipitated. They occurred between the ages of fifteen and twenty-seven mainly and, with the exception of Dr. Freiberg, osteophytes are described by each writer in at least one of his cases. The group is likewise important as the nucleus of the work of German and French writers who have in the past five years isolated into a diagnostic entity cases of identical symptomatology with those upon which my attention has been concentrated.

The five cases which appeared in 1909, had crystallized into a group which, to my mind, was sharply differentiated from other bony deforming processes in the hip-joint in children. They presented a clinical picture distinctive and worthy of separate consideration. In these cases, the general physical condition of the children reporting with a limp was opposed very drastically to a conception of deep-seated disease.

The occurrence of a traumatism, definitely related in time to the appearance of the limp, made essential the etiological consideration of this factor. The course of the affection through a considerable period of time, with slow compensatory and reparative processes, studied in radiographs, showed a relationship to the calcium metabolism of bone, which seemed to me explicable only as associated with disturbances in circulation. Beyond the characteristic limitation in abduction and internal rotation, the general facts in these cases as then published were

- 1 Age, five to eight
- 2 History of injury
- 3 Limp
- 4 Thickening about the neck of the femur
- 5 Absence of pain
- 6 Absence of constitutional symptoms
- 7 Little or no spasm

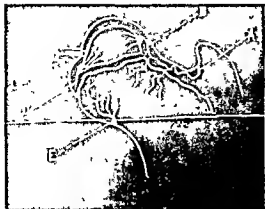


Fig 1 Adopted from Waldenstrom *A*, Upper diaphyseal vessel giving a branch *B* to the epiphysis *C*, vessel entering through the ligamentum teres, *D*, branch to the lower side of the epiphysis, *E*, diaphyseal vessel to the lower side of the femoral neck

8 Absence of shortening

9 Typical X-ray appearance

An experimental study upon atrophy in relation to disuse, the year before, had brought out interesting points with reference to circulation as an etiological factor¹

I offered in 1909, therefore, the hypothesis of trauma as the first cause producing a disturbance in the circulatory relationship between the epiphysis and the neck of the femur, the immediate result being atrophy in the former through a diminished blood supply, and hypertrophy in the latter. The hypertrophy seemed to me to be related to the hyperæmic condition induced, not only temporarily by traumatic congestion, but maintained for a considerable length of time by a proportionately increased blood supply where the blocking of the epiphyseal channels distributed a heavier circulation to the neighboring diaphyseal vessels. Adding to this disturbance the factors of pressure and growth, also through a definite period of time, my conclusion as to ultimate result was that pressure upon the epiphysis, atrophied by diminished blood supply, produced flattening, that growth, as especially stimulated in the hyperæmic upper diaphysis, produced thickening in the neck and modification in shape approximating the varus condition.

¹ See American Journal of Orthopedic Surgery August 1908

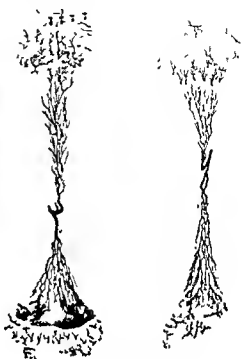


Fig 2 Adopted from Lexer Injected femora of infants showing vascular distribution

A year after this, in July, 1910, from some five hundred cases of "coxalgia," Jacques Calvé selected ten instances of a form of "pseudo-coxalgia." In his opinion, this small group of cases, apparently identical with my own, presented differential points sufficiently characteristic to warrant a special classification and discussion. In my comparative chart of symptomology at the end of this article, I give a tabulation of the principal characteristics observed by him.

Beyond the coincidence of symptoms in these cases of Calvé's, I would emphasize as bearing upon my idea of the disease the occurrence between the ages of three and one-half years and ten, the fact that the children, with one exception belonged to the working classes, a point which Emshie accentuates as in favor of the traumatic production of certain forms of coxa vara, and the otherwise excellent general health of the children.

In the study of his cases, it is interesting to



Fig. 3. N. T. 1153. Traumatic case involving both sides. Resulted in perfect recovery of motion with cap deformity of the epiphysis.

note that the three in which the onset of the affection is acute, accompanied by severe pain, fever, swelling of the joint and spasm, are the ones (II, IV, V) in which the tuberculin reaction was positive. Calvé does not consider the tuberculin test, in view of the other facts, an indication in these cases of a tuberculous lesion in the hip. The course of the disease and the end result was the same as in the other cases. The condition cleared up in six months' to a year's treatment mainly by plaster immobilization, and the radiographs were typical. Calvé's discussion of this matter is very interesting and complete.

His idea upon etiology is that earlier rachitic conditions by deforming the osseous structures in the hips and producing disturbances of metabolism were probably or possibly the first cause of the disease. He emphasizes the fact that the deformity of the hip distinctly precedes the arthritis where this is evident, that neither ankylosis in the joint nor atrophy in the femur shaft occur, that the process is brief. In spite of one case of definitely traumatic origin (III) he did not consider trauma as a causative factor. Mechanical origin from strain conditions similar to that of flat foot or genu valgum is mentioned but pronounced insufficient.

Two of the closing sentences of his discussion are suggestive. "Perhaps it should be thought that the mechanical irritation which follows in the train of this deformity, has



Fig. 4. G. Z. 859. Traumatic case involving left hip. Resulted in perfect recovery of motion with mushroom deformity of epiphysis.

created a region of lessened resistance, a point of appeal for those light customary infections which occasion chronic or subacute arthritis, never specific, such as I have described before in my article on the difficulty of diagnosis of coxalgia in its onset. . . . It appears to me materially impossible to make a conclusion on the actual state of affairs. We have only wished in this study, to point out a clinical type of arthritis of the hip, which, it appears to us, does not correspond to any type so far described and which until recently in our own opinion, has been taken for tuberculous coxitis."

Almost simultaneously with Calvé's discussion, Sourdlat, in his study of "coxalgia" called attention, in the review of two hundred and fifty radiographs, to nine special cases. Of the skiagraphs in question he claimed that the conditions were so similar, that they were practically superposable. "The articular space is enlarged, the epiphysis shows itself to be flattened; the neck of the femur is a varus more or less pronounced and generally little accentuated, it is thick-



Fig 5. I. P. 2531. Negative case involving both sides. Resulted in perfect recovery of motion with cap deformity of the epiphyses.



Fig 7. M. D. Case not reported in paper. End result recently obtained. Case of operative trauma. Pre-operative X ray.

ened." He agreed with the statements of Calvé that the arthritis in these cases is of short duration and that ossification in the epiphysis is diminished also that there are occasional rachitic appearances in the femur. He left the solution of the cause of the deformity, however, to further clinical study.

From the report of Hennig Waldenstroem on "Tuberculosis of the Neck of the Femur in

Children" Stockholm 1910 I have selected seven cases as belonging in a separate group, and to these two of the cases of Sindling-Larsen and one of Forssell as quoted by Waldenstroem have been added. These cases were first chosen as belonging in the group with my own from the study of the published schematic radiographs and the actual radiograms and were then verified by a consideration of the clinical histories. In the original article the case numbers are as follows: Waldenstroem 15 to 21 inclusive, Sindling-Larsen 1 and 2, Forssell 2.

The study of the histories brought out the following interesting points: the predominant occurrence among boys eight out of ten, trauma as the initial factor in the production of the limp in eight cases, in the two remaining cases the limp had preceded Waldenstroem's treatment by three and six years respectively, and the general condition of the children had been excellent in the intervening years: typical limitation in abduction, trochanteric elevation, constant roentgenographic appearance with flattening of the epiphysis and thickening of the femoral neck.

The general condition of the neck of the femur in these cases is one of hypertrophy with the attendant increase in density of the



Fig 6. W. C. 4925. Negative case involving the right hip. Resulted in practically perfect recovery of motion with mushroom deformity of the epiphysis.



Fig. 8a M. D. Case not reported in paper. End-result recently obtained. Case of operative trauma. Post-operative X-ray.



Fig. 8b M. D. Case not reported in paper. End-result recently obtained. Case of operative trauma. End result one year after operation.

rontgen shadow, but at points there are areas of increased radiability. Such areas are described by Waldenstroem as tuberculous foci and their location is related by him to the distribution of the upper diaphyseal circulation. Very rarely, identical regions of diminished shadow density occur in my own radiograms in cases definitely non-tuberculous. Even with the positive tuberculin or von Pirquet reaction, a diagnosis of tuberculosis from such evidence in the radiogram, in the absence of further symptoms, is at least insecure. My own experience with reference to these reactions is that they are not adequate without other data for the localization of tuberculous lesions in the hip. In this Calvé and Perthes concur. In my cases, out of fifteen in which the reaction was tried, three gave a positive von Pirquet, in these tuberculous adenitis was demonstrated.

Case 18 from Waldenstroem is worthy of especial study as a splendid developmental series of radiographs in which the stages of the flattening of the epiphysis are excellently illustrated.

Waldenstroem mentioned in his paper the condition of juvenile arthritis deformans but concluded that the etiology was widely different in the cases reported and that the subject at the time lacked the adequate unity for definite ideas for the reasons of "insufficient

observation" in cases reported, "inadequate radiograms," "rontgen examination lacking" at times, and "incomplete preparation in the pathological resections made."

Though I differ with Waldenstroem in the classification of his own cases, I have shared with him in no small degree the difficulty which he apparently encountered, as indicated in the above quotations, in his effort to study the cases presented under the name of juvenile arthritis deformans. The radiograms in many cases are so lacking in clear-



Fig. 9 J. K. ZZ 324. Traumatic case involving the right hip. X-ray taken immediately after traumatism. Subsequent changes in the epiphysis and neck identical with other cases. Resulted in slight limp and motion limitation in abduction and a cap deformity of the epiphysis.



Fig 10 J. M. LL. 1912 Traumatic case involving left hip. Resulted in perfect recovery and mushroom deformity of the epiphysis. End result X ray taken fourteen years after onset. Illustrates permanence of the epiphyseal and femoral modifications which develop during the active period of the disease.

ness, at least in the published form that a very definite idea of some of the modifications is impossible. The idea of the occurrence of osteophytes permeates the early reports, and in some of the cases, those of von Brunn for instance, I do not feel sure about the condition he describes as "*Allenthalben hängen am Raude umfangreiche Randwulste über, am starken nach unten zu*" What these overhanging marginal proliferations are whether osteophytic or not, I am uncertain, since reproductions of the X-rays are not given in the *Beiträge zur klinischen Chirurgie* in which the article by von Brunn appeared.

The general discussion of pathological anatomy, which follows his case reports, makes the condition described even more problematic. Von Brunn states that pathological examination was not possible in his cases but quotes and apparently accepts the statement of earlier authors that "marginal proliferations (*Randwulste*) or osteophytes, in the form of stalactites separate the joint cartilage from the neck." A case which really develops osteophytes does not belong to the

disease of the hip at present considered. It is possible that true osteophytes are not here described, though the word osteophyte is used, but rather irregularities in osseous deposition, since German writers, to whom the original plates are probably accessible, accept some of these cases as the disease so ably described by Perthes.

In spite of the difficulty encountered in grouping these early cases, owing to variations in the use of terms and the report of symptoms, attention and study concentrated on such cases, through the accumulation of data gradually a type was established, and a new clinical entity has emerged into the category of juvenile diseases affecting the hip.

This is very largely due to the work of Dr. Georg Perthes, who after making a preliminary study in 1910 both clinical in his own cases and bibliographical in the prior reports, in 1913, presented a classical monograph on the affection in question, and suggested at the same time a new name. This paper upon "*Osteochondritis deformans juvenilis*," not only added the data of fifteen new cases of his own to those he described in the earlier study, but it is the strongest discussion of the subject yet presented, and sharply differentiates osteochondritis deformans juvenilis from arthritis deformans on the one hand from which the former name was derived, and from tuberculous conditions on the other.

It was to hold the idea of the disease apart from that of arthritis deformans that he suggested the name to which Brandes and later writers have conformed. This differentiation is based upon the facts that arthritis deformans affects the joint cartilage, a condition clinically associated with the characteristic crepitation and that it progressively intensifies unless modified by early treatment or operation, to the point of ankylosis of the joint. The flattening of the epiphysis and the thickening of the femoral neck upon which the original similarity to the juvenile hip deformity was based occurs as an intermediate condition and is associated with those other pathological disturbances in ossification which produce pendulous outgrowths or osteophytes upon the femoral neck. Perthes, therefore, substituted for the term osteo-

arthritis, osteochondritis, because the joint cartilage is not affected but the lesions are subchondral, occurring in the bone beneath the joint cartilage. Such a differentiation was most important in eliminating an erroneous idea, but points descriptively related to the nature of the disease itself seem to me more significant in determining its name.

The clinical and roentgenological picture presented by Perthes is very perfect, and to him the medical profession is indebted for one of its classical studies. The outline of his symptom-complex is given later in conjunction with that of other writers in the comparative chart of symptomatology.

From Kiel, in September, 1914, Dr Max Brandes published a paper in which ten cases were reported and discussed. This article offers strong supplemental support to the Perthes' separation of cases of subchondral deformation of the hip in children which do not result in great limitation of movement, under the new name of osteochondritis deformans juvenilis, into a special group, and emphasizes that this should be done without reference to tuberculin reactions, subcutaneous or von Pirquet. Recovery in the hip within a reasonably short period of time with a fair range of motion raises a doubt in his mind of the tuberculous character of a case reported. His statement concerning the tuberculous neck foci of Waldenstroem is considerably more sweeping than my own, and the complete series, in his opinion, should probably be grouped as osteochondritis deformans juvenilis. He further suggests that the notably successful cases of the treatment of tuberculous arthritis of the hip in children are not the results of improved treatment in this disease, but mistaken diagnoses of tuberculosis of the hip for osteochondritis deformans juvenilis in which the end-results of the latter disease have been attributed to the former.

Very recently, in the April number of *The American Journal of Orthopedic Surgery*, Dr Francesco Delitala has contributed an article upon this subject to which the name of Perthes' disease is applied. His study covers the especially interesting phases of the work of Perthes, Schwartz and Negroni, particu-

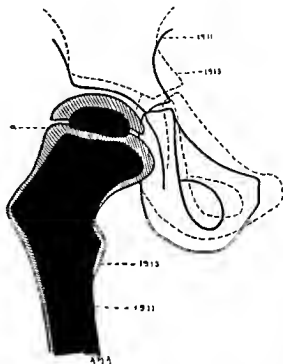


Fig 11 Diagram to show modifications of epiphysis and neck. Made in exact outline by lens superposition and reduction from original X rays, in case of H. M. 1911 was taken immediately after the onset before bone modification had occurred. 1913 is the end result of the series of radiograms. The pelvic changes are those to be normally expected of growth and have not been emphasized in the diagram but only given in outline.

larly from the point of view of the pathological anatomy as far as it is at present known, and makes the further review of the matter he has so ably discussed unnecessary here. After the presentation of my own cases, however, I shall be obliged to differ from him on points in the etiology and the early bone changes more completely than is necessary with any other contributor to the investigation of this disease.

For the past nine years I have been studying this special hip affection, and I have followed the subsequent history of my earlier cases and added to the number of my observations until my present statistics cover fifty-five personally observed cases. This study has not led me to change my earlier opinion upon etiology, and I am prepared to strengthen and elaborate from considerably augmented data the conclusion arrived at in 1909.

To a consistent view of the etiology and course of this disease, a preliminary survey of the facts of circulation in the hip region involved is necessary. Circulation in the epiphysis and neck was worked out by Lexer, and somewhat later more completely by Waldenstrom by means of vascular injections of crude turpentine and mercury. The radiographic study of these injected femora established the occurrence of (a) a vessel to the upper neck entering just above the great trochanter and giving a branch to the epiphysis of the head, (b) a vessel on the under side of the neck, (c) a small vessel to the under portion of the epiphysis, similar in distribution to the epiphyseal branch of (a) above; (d) a vessel of small size and limited ramification passing into the epiphysis through the ligamentum teres (see Fig 1). The distribution of the epiphyseal vessel is circular, coming up from the diaphyseal region and turning into the epiphysis in such fashion as to surround the epiphyseal line like a calyx (see Fig 2). Some of the vessels interlace so far as is determined across the epiphyseal line. A close comparative study of the arrangement of the circulation with reference to the epiphyseal line shows definitely that a trauma which effects an actual or approximate epiphyseal dislocation would create a very great disturbance in circulation and would necessitate at this region of bone increase a regeneration of the capillary and immediately supracapillary vessels of the utmost importance to the calcium metabolism and growth.

Hjyrtle has claimed that the vessel into the ligamentum teres turns back upon itself without taking part in the vascular nourishment of the epiphysis. Lexer's researches were upon infants and other anatomists at that time claimed that the vessel extending into the ligament did not function after the age of two years. Waldenstrom however demonstrates this vessel in children of five but shows a very limited ramification for it, with a comparatively small relation apparently to nutrition. In view of the research upon the origin and function of the ligamentum teres by Morris, in which his conclusion is that this ligament is a modified tendon of the pectineus muscle (ambiens) which in lower animals

serves as a check on certain muscle combinations in rapid movements, it is quite possible that the conflicting opinions on the vascular supply of the ligament indicate varying degrees in the development of the circulatory channels here. Evolutionary study very generally shows much individual variation in an organ of transferred or disappearing function.

The circulation in this entire region is I believe a factor of extreme importance. In connection with the demonstration of the relation of circulatory stoppage to ossification in the neighborhood of the epiphyseal line, I have under way a series of experiments upon animals, which I trust will give definite results as to the modifications of calcium metabolism after interference with the circulatory channels.

As systematic clinical data bearing intrinsic evidence in occurrence, association, and development, to a circulatory disturbance in osseous deposition and absorption in the epiphysis and upper diaphysis, of which a traumatism is the first cause, I now bring forward the fifty-five cases already mentioned.

My earliest interest in these cases was awakened by the fact that the children came in at the Out-Patient Department of The Children's Hospital on account of a limp only. Associated with this single abnormality was no special complaint of pain, no prior conditions of disease, no definite symptoms of the customary pathologic coxal affections. In general the appearance of the limp, in spite of its frequent relation to a traumatic experience of some sort, had produced no disturbance in the normal avocations of the child's life, and had created no special concern in the minds of the parents. In time, however, the persistence of the claudication began to have weight. The parents individually were led to consult a physician out of a vague concern for the child's welfare, rather than from any personal complaint on the part of the child. These children were in all cases strong well developed, active in their habits, and thoroughly accustomed to the exuberant exercises of their period of life.

The clinical examination of the limb affected showed, besides such slight oscillations from the mean as occur in individual cases of any disease, the following symptoms, with which I have combined certain facts of occurrence and history:

1. Age, two and a half to twelve years
2. Appearance of a limp, with relation to a distinct traumatism in thirty-seven cases¹
3. Trochanteric prominence on the side affected in standing position; apparent visually and upon palpation.
4. Limitation in motion marked in abduction; slight in internal rotation Flexion free.
5. No crepitation
6. Capsular thickening about the neck of the femur.
7. Slight muscular atrophy on the side affected
8. Little or no pain either subjective or upon manipulation²
9. In general, little or no spasm³
10. Trochanter slightly above Nelaton's line
11. Positive Trendelenburg generally present
12. Leg length equal with occasional variation either in shortening or lengthening.⁴
13. Von Pirquet negative Tried in fifteen cases with positive results in three in which tuberculous adenitis was present
14. Wassermann and luetin tests negative. Tried in five cases without reaction.
15. Family history negative
16. Patient's history negative, with the exceptions given in thirteen The ordinary diseases of childhood had occurred in various individuals There were no disease symptoms of any sort for a period of six months prior to the onset of the hip affection
17. No evidence of old rachitic condition

18. Duration from six months to a year, varying with the intensity of the attack.⁵

19 Typical rontgen appearance consisting of an atrophied flattened epiphysis, either cap-like or mushroomed in shape (see Figs 3 and 4 for types), hypertrophic thickening of the neck of the femur; an appearance of coxa vara These modifications are persistent, but after the subsidence of the first attack, not progressive.

The clinical data concentrated from the original histories, the record number of which is given in each case, is presented in the following tables. I have divided the fifty-five cases into three groups.

I Cases in which the patient definitely associated the appearance of the limp with a traumatic experience, listed as "Cases of Known Trauma"

II Cases in which the parents did not report a trauma, but the child began to limp at a definite time without relation to prior disease, listed as "Negative Cases"

III. Cases following reduction of congenital dislocation, listed as "Cases of Operative Trauma"

A study of the first group, in addition to the constancy of symptoms in general, brings out several interesting points:

1. The greater occurrence in males than in females, in the proportion of nine to one.

2. The distribution of the affection between the ages of five and eleven, to which there is but one exception

3. The fact that 50 per cent of the cases, came in for treatment from six months to four years after the limp was noted.

4. The sporadic occurrence of symmetrical cases involving both hips, two out of twenty-two

The "Negative Cases" are less susceptible to generalization than the "Traumatic" group A marked preponderance of males to females still exists, in a lower proportion, however (22 to 1). There is an association with pain in two cases, both girls, and both showing a greater motion limitation than usual. There are two symmetrical cases The varia-

¹ This refers to the active duration of the disease which I consider the period during which osseous modification is occurring in the joint. This is the period during which treatment is valuable. The permanence of the joint deformity results very often in a permanence of the limp and motion limitation long after the disease has run its course.

¹ This number includes the cases in which the bone modifications followed operation in cases of congenital dislocation of the hip. See Group III following

² A moderate amount of persistent pain occurs occasionally. A special note to this effect is given in the tables wherever pain was reported.

³ The sporadic occurrence of persistent spasm is indicated in the tables which follow

⁴ Shortening occurs rarely (2 cases) and is marked (from 2 to 15 inches). Lengthening is also rare (2 cases) and is much more moderate in degree (from 1 to 15 inch). There is apparently no difference in such cases in the X-ray findings or the clinical course. These figures do not refer to cases of congenital dislocation of the hip

TRAUMATIC CASES

Record	Age	Sex	Etiology	Hip Affected	Motion Limitation	Articular Thickening	Type of Epiphysis	Recovery
J G 6373	5	M	Fall 1 week	Right	All limited	Slight	Cap	Perfect
J W & L A 125	3½	M	Fall 2 years	Left	Abduction Internal rotation	Slight	Cap	Limp improving
W M A A 335	4	M	Fall 4 months	Right	Abduction Internal rotation	Slight	Mushroom	Slight limp and limitation
C Z 895	5	M	Fall 9 months	Left	Abduction Internal rotation	Slight	Mushroom	Perfect
E W 5737	5	M	Fall 4 years	Right	Abduction Internal rotation	Slight	"	Perfect
R A N X 364	5	F	Fall	Right	Abduction Internal rotation	Slight	Cap	Perfect
J K 4663	5½	M	Kick 1 week	Left	All motions Slight limitation	Slight	Cap	Slight limp and limitation
V T 1153	6	M	Fall 1½ years	Both	Abduction	Slight	Cap	Perfect
J E G & Private	6	M	Fall 6 months	Left	All motions Spasm on 1 pain	Slight	Cap	End result not reported
J M L L 194	6	M	Fall 2 weeks	Left	All motions slight Slight spasm	Slight	Mushroom	Perfect
J M L C L 41	6	M	Fall 3 months	Left	Abduction Internal rotation	Slight	Cap	End result not reported
J D 5263	6½	M	Fall 6 months	Right	Abduction Internal rotation	Slight	Cap	Slight limp and limitation
J K Z C 344	6½	M	Fall 5 weeks	Right	Abduction Internal rotation	Slight	Cap	Slight limp and limitation
L D 5196	6½	M	Struck 2 months	Left	Considerable general limitation Spasm and pain	Slight	Cap	Perfect
F S 3347	7	M	Fall 1 month	Left	Abduction internal rotation Slight spasm	Slight	Mushroom	No limp slight limitation
C M 4134	7	M	Fall 2 months	Right	Abduction Internal rotation	Slight	Mushroom	No limp slight limitation
M M 73	8	F	Fall 9 months	Both	Abduction internal rotation slight general	Slight	Mushroom	Perfect
R H 317	8	M	Fall 9 months	Right	Abduction Internal rotation Slight spasm	Slight	Cap	Slight limp and limitation
F M T E 537	10	M	Thrown by cow 3 months	Right	Abduction Internal rotation Slight spasm	Slight	"	Perfect
W R Private	10	M	Fall 9 months	Left	Abduction Internal rotation	Slight	Mushroom	Perfect
A T 9403	11	M	Fall 10 months	Right	Abduction Internal rotation	Slight	Mushroom	Excellent Case

¹ Shortening of the leg affected one-half inch in F S 3347

² Necrotic area developed during observation of case. excision: staphylococcus present

³ An osteotomy performed for coxa vara with good results

* X rays broken in scoring. Classification into types of head made subsequently to limb.

Perfect recovery cases are without limp or limitation in motion. The recovery in all cases is complete though a slight persistent limp and motion limitation persists after recovery in about 50 per cent of the cases.

tions which occur in no way preclude a possible unreported trauma, nor does the course of the affection and the end result depart from that of the positive traumatic cases. The X-ray findings are identical in the two groups, and any history of a pathological hip process, prior or subsequent to the period of limp and treatment, is lacking. The clinical

data taken under consideration by the physician is constant throughout the patient's history, always susceptible to personal fluctuations both of memory and accuracy, is the variant. The latter factor, is I believe frequently to blame for the omission to note or report the relation of a trauma to the onset of the symptoms.

NEGATIVE CASES

Record	Age	Sex	Onset	Hip Affected	Motion Limitation	Articular Thickening	Type of Epiphysis	Recovery
A N 5622	3½	M	Limp 6 weeks	Left	Abduction Internal rotation	Slight	Mushroom	Perfect
H M 4558	4	M	Limp 3 months	Right	Abduction	Slight	Cap	Perfect
G D T 50	4	M	Limp 6 months	Right	Considerable general limitation Considerable spasm	Slight	Mushroom	Slight limp and limitation
F L ZL 289	5	F	Limp 6 months	Left	General limitation Spasm slight pain	Slight	Mushroom	Lengthening, left
A D 4336	3½	F	Limp 5 months	Right	Abduction Internal rotation	Slight	Mushroom	Shortening right
F B 4454	3½	M	Limp 2 months	Left	Abduction Internal rotation	Slight	Mushroom	Slight limp and limitation
F B 1130	3½	M	Limp 3 months	Left	Abduction Internal rotation	Slight	Cap	End result not reported
W C 4025	3½	M	Limp 3 months	Right	General	Slight	Mushroom	Very slight limp and limitation
E E 2552	6	M	Limp 6 months	Both	Abduction Internal rotation	Slight	Cap	Perfect motion Shortening right
W L CCC 163	6	M	Limp 1 year	Right	Abduction Internal rotation	Slight	Cap	Very slight limp and limitation
C M 3532	6½	F	Limp 6 weeks	Right	Abduction Internal rotation	Slight	Mushroom	Very slight limp and limitation
R H 6934	7½	M	Limp 3 months	Right	Abduction Considerable spasm	Slight	Mushroom	Present case
O M 1943	8½	M	Limp 2 months	Left	Abduction marked Slight general Slight spasm	Slight	Mushroom	Perfect
L A 1976	8½	F	Limp 3 months	Left	General limitation Spasm slight pain	Slight	Mushroom	Lengthening left
E M X 358	9½	M	Limp 7 months	Right	Abduction	Slight	*	Slight limp and limitation
R C AAA 72	11	M	Limp 1 month	Right	Considerable general limitation	Slight	Mushroom	Perfect motion Shortening right
E P LFL 48	11	F	Limp 1 year	Right	Slight general limitation	Slight	Mushroom	Perfect
E E 5437	11	M	Limp 3 weeks		Considerable general limitation Slight spasm and pain	Slight	Mushroom	Slight limp and limitation

* G D Nine months prior to disease had an abscess in groin. Healed without treatment. Had apparently no relation to affection in hip.

* L A D L A R C Lengthening or shortening may occur.

* X Ravi broken in moving. Classification into types of head made subsequently to loss. There is a noticeable preponderance of the mushroom type of epiphysis in this group. It is constant in females and rather generally associated with general limitation and spasm. The number of perfect recoveries is lower in this group. Recovery with the slight deformity noted occurs in all cases, however.

The third group, "Cases of Operative Trauma" must naturally come under a distinct head. The process of reduction of congenital dislocation of the hip by manipulation is very generally a process involving no small frictional strain upon the epiphysis and upper diaphysis of the femur. In these cases, the reduction was accomplished with difficulty and several manipulatory operations were required. Variations in this group hardly need be considered, for they are determined primarily by the initial deformity and bear no relation to the flattened condition of the epiphysis with its correlated neck variation.

The congenital dislocation of the hip is notably more frequent in female children, and all cases in this table will be observed to be girls. The earlier age of occurrence is ordinarily determined by the time of operative interference. The constancy of the symptoms associated with flattened epiphyses of sporadic occurrence is all the more valid, however, for the condition of the epiphysis before the hip is reduced is always well known, and the resulting flattened condition is very definitely consequent upon the traumatic strain necessitated by the operative return of the femur head to the acetabulum.

CASES OF OPERATIVE TRAUMA

Case	Age	Sex	Shank	Humeral	Station Location	Type of Deformity
A. C.	18	F	Left	Left	Anterior	Madriosis
M. C. D.	19	F	Right	Right	Anterior	Cap
H. D.	19	F	Left	Left	Anterior	Cap
A. M.	20	F	Right	Left	Anterior	Cap
M. S.	20	F	Right	Right	Anterior	Cap
E. B.	21	F	Left	Left	Anterior	Madriosis
C. C.	21	F	Left	Left	Anterior	Cap
H. J.	21	F	Right	Right	Anterior	Internal rotation
E. C.	21	F	Right	Right	Anterior	Internal rotation
H. D.	21	F	Right	Left	Anterior	Internal rotation
H. B.	21	F	Right	Right	Anterior	Internal rotation
C. T.	21	F	Left	Left	Anterior	Cap
P. B.	21	F	Right	Right	Anterior	Cap
E. M.	21	M	Right	Right	Anterior	Madriosis
E. F.	21	F	Left	Left	Anterior	Internal rotation
N. V.	21	F	Right	Left	Anterior	Madriosis
A. B.	21	F	Right	Right	Anterior	Internal rotation

The femoral head in congenital dislocation cases is small and very much retarded in development, not only with reference to size but in degree of lime depositing in the ossified center. The contour however is normal and the epiphysis well defined even where it shows a diminished radiability, probably atrophic. Such epiphyses in addition to undergoing traumatic strain upon rotation are already in a condition of ossification little calculated to endure pressure strain (see Figs. 7 and 8).

This group of cases of operative trauma has been particularly interesting to me because it has offered for study an experimental traumatism which can be watched throughout its course and because it presents variations in epiphyseal relation to weight bearing which are worthy of the closest study. I find that Peethers and Brander have in their own work also arrived at the conclusion that the epiphysis must wait a longer period of congenital dislocation in its development to that which occurs in more acutely defined trauma, but they have not entered upon the study of these cases as helpful in determining the relation of the traumatic or traumatic dislocation to the epiphysis of the femur.

The number of the cases studied is ten

great to give the detailed histories of every case, therefore I have endeavored to concentrate into this triple chart the points which I consider essential to this discussion. The symptomatology already given covers all minor details which are very constant and notes on all special variations are added.

I present in addition a group of typical X-ray reproductions illustrating the subluxations above. Figures 3 and 4 show cases of known trauma, the former showing a cap deformity of the epiphysis, the latter the domed mushroom-like modification. Recovery in both cases has been complete. Figures 5 and 6 are of two similar cases in which trauma was not reported. Figures 7 and 8 are pre-operative and post-operative radiographs of a case of congenital dislocation of the hip. Figure 9 is a case immediately after a traumatism in which the radiogram was secured before the circulatory changes and resultant bone modifications have taken place. The end result in this case was a femoral with those above. Figure 10 is a radiograph of a case taken thirteen years after the original deformity and shows the persistence of the epiphyseal and femoral changes.

In all of these radiographs it is noticeable

SYMPTOM-COMPLEX

LEGG	CALVE	PERTHES	BRANDES
Occurrence 1½ to 12 years.	1½ to 10 years	3 to 10 years	4 to 13 years
Onset Appearance of a lump with frequent relation to trauma	Variable onset, with pain or the appearance of a lump only	Appearance of a lump	Appearance of a lump
Trochanteric prominence on side affected		+	Prominence of the great trochanter
Limitation of motion marked in abduction slight in internal rotation Flexion free	Limitation in motion	Marked in abduction in varying degree in internal rotation Flexion free	Limitation in abduction almost total adduction and rotation limited in varying degrees Flexion fully free
Capitular thickening			
Little or no pain subjective or upon manipulation	See onset	No pain	No tenderness or sharp pain
Little or no spasm		No reflex muscle spasm	+
Trochanter slightly above Aclaton's line		Trochanter high	Trochanter well above Aclaton's line
Positive Trendelenburg		Trendelenburg's symptom present	Positive Trendelenburg
Legs equal in length with occasional exception		Legs equal in length	Shortening on affected side
Muscular atrophy glutei.		Muscular atrophy of glutei	Muscular atrophy of thigh
No crepitation		No crepitation	No crepitation
Von Pirquet negative		Von Pirquet in general negative	+
Wassermann and Judd tests are alive			
No evidence of old rachitic condition	Skeletal indications of rickets	No evidence of old rickets	No report of rickets
Short active duration six months to a year	Short duration	Short active duration	+
Persistence of bone deformities	+	+	+
Typical roentgen appearance 1 Atrophied flattened epiphysis can-like or mushroom in shape 2 Hypertrophic thickening of the neck of the femur 3 Apparent coxa vara.	Typical roentgen appearance 1 Flattened epiphysis with marked variations in density 2 Hypertrophic neck of femur 3 Apparent coxa vara	Typical roentgen appearance 1 Flattened epiphysis with focal points of diminished density in early stages 2 Hypertrophic neck modification of the femur 3 Acetabular modification in accordance with the change in the epiphysis in late stages	Typical roentgen appearance 1 Flattened epiphysis domed or pistoleke Variations in density 2 Hypertrophic modification of the neck of the femur 3 Late acetabular modifications

NOTE — The comparative symptom-complex is intended only to indicate the extreme similarity between the points of diagnostic value which have been brought out by various writers on this subject. Points omitted in the second, third and fourth columns as shown in the following special notes are often not given because I have not felt at liberty to insert into their syndromes points from the general text of the writers quoted.

1 This point is given by Perthes covers the prominence of the trochanter possibly as well as the elevation.
2 Muscle spasm is discussed by Perthes particularly in connection with the disappearance of the spasm under anesthesia. Perthes refers to spasm in the same connection. Similarly in my own text spasm immediately after trauma as related to the bone modifications is discussed. Both pain and spasm are incident in general to injuries but they are not in my experience persistent characteristics of this affection of the hip joint though as both treated by Brandes in the general text.

3 The persistence of the bone modifications is axiomatic I believe and only omitted by other writers as a point obvious to itself which requires no special discussion.

as Perthes has also observed, that the displacement of the epiphysis is upward and outward in place of inward and downward as occurs in epiphyseal displacements of the type reported by Weil, which amount to actual fractures and frequently produce one type of coxa vara.

The change in shape and position of the upper epiphysis is, I believe, related to the limitation in abduction which is so constant. Both Perthes and Brandes do not believe the

limitation is caused by the deformity, because they find that under anesthesia free abduction returns. My own results do not strictly accord with their statements. Anesthesia in many cases does not remove the limitation.

It seems most probable, in view of the data from all sources, that muscular limitation is primarily the cause of the deformity, in place of its result, particularly where trauma is by demonstration or hypothesis the etiological factor. A traumatism which produces a

muscular limitation in abduction, an adductor spasm, by persisting during a period of disturbed ossification, with vascular regeneration and redeposition of calcium mechanically would result, in all likelihood, in just such structural modifications as occur in the epiphysis. The adductor contraction is, I believe, responsible for the initial limitation in motion, and so far as I can determine by clinical and roentgenological study is related, as I have just suggested, to the production of the hony deformity. The osseous modification, upon becoming permanent, however, creates a secondary persistent limitation in abduction, which is determined, at least in part, by the positional and shape modifications of the femoral epiphysis and neck.

The thickening of the neck of the femur, which shows in the radiograms, is quite distinct from the synovial and capsular thickening, which is palpable. The decreased radiability or greater shadow density of this region and the associated increase in spherical diameter is, I believe, partly due to bone increase through periosteal activity, such as occurs in callus formation in more serious cases of trauma. An appearance of coxa vara is the result, a modification not due to any real bending of the femoral neck or tipping of the epiphyseal margin of the diaphysis, but is a uniformly widening bone layer which increases proximally. This increase is more apparent on the under surface where it diminishes the obtuse angle of the shaft and neck. I show this in the accompanying diagram (Fig 11), in which the original femur is presented in black, the bone addition and the positional and morphological modification of the epiphysis is shaded in with cross lines. The widening of the new bone formation toward the epiphyseal line is as nearly as possible in direct proportion to the increased density of the radiographic shadow. Just below the epiphysis in the diaphysis, there are frequently areas of increased radiability similar to those occurring in the epiphysis itself. These indicate areas of diminished resistive strength to pressure and result often in a slight rounding off of the upper diaphyseal angle (see *a* in Fig 11), or possibly in a flattening such as occurs in the head

All of the observations on osseous modification are roentgenological. There is never a necessity for operation in the disease, and as the affection is never fatal a study of the changes at autopsy must remain unaccomplished until determined by fortuitous circumstances.

The two distinct types of end-result of the deforming process in the epiphysis are interesting. The cap deformity seems to follow irregular disturbance in the ossification, which produces regions of extreme radiability alternating with areas of undisturbed ossification. These are described as "bony islands" by other writers. The mushroom shape apparently results from evenly distributed atrophy, as though lime absorption occurred uniformly throughout the epiphysis, and that under evenly distributed pressure on a body of lessened resistance the entire epiphysis had flattened. Two such forms would be logically expected from a circulatory disturbance: the former occurring where the blood-vessels were occluded only at points, the latter where the disturbance was general. The fact that ossification is renewed in the cap type by the reappearance of lime about the margins of the "bony islands" until these grow together and become welded into a continuous ossified mass is very interesting since, hypothetically, at least, it could be related to the regeneration of the capillary system from the vessels which remained intact in the areas of undisturbed ossification. I advance this at present as a suggestion only.

The traumatic conception of etiology is excellently supported by the history of the disease itself. If one reviews the facts of occurrence and course, it is found that a spontaneous affection in a joint arises without so far as can be determined any systemic or infectious disease-producing cause. An initial mild acuteness, as far as symptomatology is concerned, passes through a gradual self-reparative process and gives generally an end result, frequently without any assisting treatment, of a slight persistent limp and motion limitation, or a perfect recovery. Such a combination of onset, course, and end-result, is typically traumatic, and the strictly accessory nature of the treatment is quite

similar to that which is possible in cases of more serious traumatism.

Concerning the treatment of this affection of the hip, there is very general agreement among all writers. From the time I watched the course of my first case, it has been my opinion that very little treatment is necessary. In milder cases, results have been equally good with or without immobilization. A simple flannel spica has been used in many of these. On severer cases, especially where there is spasm or great limitation of motion, a plaster spica should be applied. The healing process tends to come about naturally and by watching the patient and affording any accessory which diminishes strain upon the hip to facilitate recovery by means of repair, is all that can be done.

The osseous modifications in the hip during this repair, as observed roentgenologically, lead to an end-result of deformity which is permanent. The slight limp and motion limitation, as reported in cases in my charts after recovery, is associated with this persistence. The case of J. M., LL 192, has been observed for fourteen years and the most recent roentgenograph, taken March, 1915, at the age of nineteen is given.

Of the supposition advanced by certain contributors to the literature that liability to this disease is hereditary, I find no support in my clinical experience. It is probably true that certain individuals are more liable to marked results from injury than others. Exactly as the lime composition or a slight variation in shape, combined with a trauma, influences the degree or even the occurrence of a fracture, individual variations in the shape or positional relations in the hip would be a factor determining the result of a sudden impact. Familial occurrence of the disease, in its occasional report by others, may be related to such a variation. The occurrence in children of exuberant vitality and the predominance in males coordinate the disease with personal activity and participation in violent sports and associate sporadic duplication of the disease in families with habits of life rather than hereditary tendency. Fractures studied in the same fashion would give an equally familial distribution.

The proportionate occurrence in boys is very marked in all reports and lends supporting circumstantial evidence to the idea of traumatic origin. In my cases, in those of known trauma, the proportion is nine to one; in the negative group, two to one; Brandes' proportion is seven to three; Perthes', four to two in one group, and thirteen to two in the other; cases from Waldenstroem's group give the ratio of four to one; Calvé's, four to one; Delitala's, eight to zero.

It is upon his idea of origin that I feel obliged to differ very radically from the last-named writer. The idea of a "congenital alteration, either of the epiphyseal cartilage of the upper end of the femur or of the epiphyseal nucleus, which gives way to processes of ossification which are insufficient and irregular" which is largely restricted to males and develops at varying ages in childhood without prior indication of the existence of such a condition, is not within the range of acceptance of my clinical study and treatment of the disease.

Modern research along Mendelian lines does substantiate, in germ-cell qualifications, transmission of characteristics in one sex only, but the appearance of a congenital lesion unrelated to any of the special phases of life, such as adolescence, has very little foundation, and the close regional association of atrophy and hypertrophy is as drastically opposed to the idea of a congenital systemic affection, as it is favorable to the conception of a circulatory lesion, traumatic in origin.

The case of my own which was most interesting to me in the study of the disease was the one of J. K., ZZ-324, in which an X-ray taken immediately after the trauma presented an absolutely normal hip. In the course of a few months the typical bone changes were present. I am not ready to present this case, as strong as the evidence is to me, as forcibly as it deserves, for the reason that in moving the plates of the hospital from the old location to the new building, the later plates were destroyed and I have been unable to replace the final plate giving the end-result which would still be possible if the child could be traced. The original plate and the history of the case are still in our records, however.

Waldenström in one of his cases (17), without reporting a trauma, presents the radiogram immediately after a limp of one week's duration as normal and shows later radiographs with flattening of the epiphysis and changes in radiability.

The rare cases in which the affection is bilateral, which have occasioned considerable speculation, are not inharmonious with the traumatic production of circulatory lesions. The arms are very rarely affected in the same way by a fall or accident of any sort; in many instances, however, the legs receive the impact of a fall similarly and simultaneously. Such a jar is always incident to a false landing from a high jump and to falls which throw a child on the knees. Circulation is noticeably more strictly bilaterally symmetrical in the distribution, in the size of vessels and current maintained, in the lower half of the body where use of the muscles and nerves related to vascular control are associated with symmetry of function. Though such an accordance between the possibility and the occurrence has no direct weight upon the acceptance of the hypothesis, it is at least wise not to attach one's opinion to an explanation of disease which cannot be brought into accord with all the known facts.

Occasional secondary infections occur in cases of this disease. Waldenström's idea that the local circulation determines the lesion in the hip is correct though these lesions are not early tuberculosis. Calvé's suggestion, as already quoted, that "regions of lessened resistance" establish in the hip points of appeal for light customary infections in some few cases is true, but the lessened resistance is determined by trauma as I see it instead of by rickets. The onset of such symptoms of infection is strictly secondary, occurring some months after the original disturbance. In no instance have I found the apparent renewal of disease to be tuberculous.

It is from the point of view of differential diagnosis that the etiology of the affection is most important. The thorough understanding of the nature and possibilities of circulatory lesions due to trauma in the hip makes the separation of these cases from early tuberculosis very simple, and as the treatment for

the two affections differs widely and it is important that tuberculosis should have correct treatment early, every step which differentiates more clearly other affections by elimination makes the diagnosis of tuberculous coxitis more secure. The immediate report of these cases after trauma may reduce the resultant deformity, if adequate protection from pressure on the epiphysis can be secured, a result which equals in its value to the individual, the more general professional gain to the diagnostician.

The present evidence from all sources is that, in general, the cases do not report until the limp is established. Should the medical profession succeed in associating this permanent though slight deformity with traumatism to the hip, earlier reports of the cases might result and genuinely perfect recovery without slight limp and motion limitation would be more frequently secured.

In spite of the long series of names which have been attached to this disease, in behalf of the conception of etiology which is important both to diagnosis and treatment, it is my desire to suggest a change of name to accord with the etiology. Having thought considerably on the subject and discussed a varied nomenclature with many members of the profession osteochondral trophopathy appears to condense as much as possible a name descriptive of the characteristics of the disease and seems no more complicated than the terms already applied to the affection. Analysis of the words employed makes unnecessary any explanation as to their selection.

In conclusion I wish not to summarize the cases presented nor to discuss questions of symptomatology and treatment, but to emphasize as much as possible through my work, the importance of an etiology which is entirely in accordance with clinical data and which has for a number of years proved serviceable in diagnostic work.

I wish to extend my grateful acknowledgment to Dr S. Burt Wolbach of Boston for the suggestion of the name which has seemed most suitable to me, to Dr Percy Brown of Boston for the excellent roentgenological end-result secured in the case of J. M., Fig. 10.

and to Mrs A. M. Anderson, who has rendered invaluable assistance in the construction of the paper

BIBLIOGRAPHY

- BRANDES, MAX Über Osteochondritis deformans juvenilis Ztschr f klin Chir, 1914
- CALVÉ, JACQUES Difficultés du diagnostic de la coxalgie au début La Presse méd., 1909, February 17 Sur une forme particulière de pseudo-coxalgie Rev. de chir, 1910, July 10
- DELITALA, FRANCESCO A typical disease of the femur Am J Orth Surg, 1915, April
- ELLIOTT, G R Obscure traumatism of the hip Acad Med, Sect Orth Surg, N Y, 1898, October 21
- ELMSLIE, R C Coxa vara its pathology and treatment Internat Cong Med, Lond, 1913, August
- FREIBERG, ALBERT H Coxa vara adolescentium and osteoarthritis deformans coxae Am J Orth Surg, 1905, July
- HOPF, A Handbuch praktischen Chirurgie, Osteoarthritis deformans Coxae juvenilis Deutsche med Wchnschr, 1907
- HOTZEL and ROTTENSTEIN La carie sèche de la hanche Rev de chir, 1910, February 10
- IMMELMANN Osteoarthritis deformans coxae juvenilis Deutsche Ztschr f Chir 1907 Deutsche med Wchnschr, 1907.
- KIRMISSON, E Des luxations soudaines au cours de la coxalgie Rev d orth, Par, 1899
- LEXER, L Die Entstehung entzündlicher Knochenherde und ihre Beziehung zu den Arterienverzweigungen der Knochen Arch f klin Chir, 1903, lxxi
- MAC CREA Osteoarthritis deformans juvenilis J Am. M Ass, 1904
- MENARD, V Etude sur la coxalgie Paris 1907, p 159.
- PETHES, GEORG Über Arthritis deformans juvenilis Deutsche Ztschrift f Chir Leipzig 1910 Über Osteochondritis deformans juvenilis Verhandl d deutsch Gesellschaft f Chir, Berl, 1913, xlii, 2
- SCHWARTZ, ERWIN Zur Frage du spontanen Epiphysenlösung (intracapsulären Schenkelhalsfraktur?) im Kindesalter Über die Coxa vara congenita. Beitr z klin Chir, 1913
- SOURDAT, PAUL La coxalgie en radiographie Arch prov de chir, 1910, January
- STHAL, JOACHIM Über Coxa vara traumatica infantum Arch f klin Chir, 1899, lx, 71
- VON BRAUN, MAX Über die juvenile Osteoarthritis deformans des Hüftgelenkes Beitr z klin Chir, 1903, xl
- WALDENSTROM, HENRIC Die Tuberkulose des Collum Femoris im Kindesalter From the Surgical Division of the Children's Hospital of the Crown Princess Louise of Stockholm
- WEIL, S Über doppelseitige symmetrische Osteochondritis dessecans Beitr z klin Chir, 1912, lxxvii.

DEATHS ATTRIBUTABLE TO INTRANASAL OPERATIONS AND OTHER INSTRUMENTATION

A CRITICAL REVIEW WITH REPORT OF EIGHT UNPUBLISHED CASES, ONE PERSONAL¹

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THAT death should follow cauterization of the nasal mucosa, or after diagnostic puncture, irrigation, or perfusion of the antrum of Highmore is surprising and not to be expected, as thereby violence is not done any vital structure, nor are any channels laid open for the transmission of toxic material, especially as in the latter instances death was almost instantaneous. On the other hand, it is still more surprising that more deaths do not occur after such instrumentation as probing the various sinuses, the attempted introduction of cannulae and the curettement of them, or from operations on those structures and the bony septum, when their intimate connection with the cranial cavity and the meninges is recalled, not only through the medium of the blood vessels and lymphatics, but also by actual continuity of tissue. Moreover, when it is considered that removal of the middle turbinate, itself but a wing of the ethmoid labyrinth, lays bare numerous new channels for the transfer of infective material straight to the meninges by way of the porous and poorly resisting ethmoid, the ensuing death should never surprise, however much it may distress, the conscientious attendant. Similarly, the removal of nasal polypi is singularly free from danger, as a rule, when it is fully appreciated what their presence signifies, as it is fairly certain that the periosteum always and the subjacent bone nearly always are diseased. Consequently, to disturb this necrotic area with the added hazard of trauma (as most polypi are thus removed—avulsion) must set free infection in the presence of new areas for absorption in a region that is always dangerous—the middle and superior straits of the nasal chambers. The most elementary knowledge of anatomy would cause appreciation and respectful consideration for the dangers of any operation on the bony nasal

septum, especially any that encroached upon the ethmoid perpendicular plate, and the radical frontal sinus operations are so obviously critical that deaths from this latter class are not even considered here, save in one case where the fatality was directly due to the removal of the middle turbinate and disturbance of the ethmoid in the presence of an acute suppurative ethmoiditis and frontal sinus empyema. When infection does occur it is to be accounted for not only by the virulence of the bacteria, but also by the laying open of wide venous and lymphatic spaces with their free communications with the subdural and epidural channels. The intimacy of this relation has been shown clearly by Schwalbe, Michel, Key and Retzius, and Cunco and André, who severally show that the cribriform plate of the ethmoid is the point of communication between the nose and the dural spaces, either by the venous or the lymphatic route, and by the fibers of the olfactory nerve. Logan Turner is rather skeptical as to the responsibility of the lymphatics for the spread of infection in the nose, and he quotes Gerber, Gyselynck, Mayer, Hoffmann, Huguenin, Ogston and Warner, all of whom report a series of infections from empyemata of the accessory sinuses, which would seem to show, in the main, that the lymphatics conducted the toxin less often by far than any other method. Ortmann's case, for example, reveals the infection as spreading by continuity of inflammation through bony walls.

The comparative freedom from fatal infection following operations within the nose has encouraged considerable speculation and theorizing as to the cause of this immunity, some of which are as follows: a special bactericidal power on the part of the nasal mucus (2), that it is a poor culture medium for bacteria (3), its mechanical function in agglutinating the bacteria and preventing

¹ Read before The American Academy of Ophthalmology and Otolaryngology, October 1925

their activity (42). Certainly the film of thick secretion that exists over the nasal mucosa does act as a protective curtain against dust and other foreign bodies, and it is not entirely unreasonable to attribute this same effect where bacteria are concerned. However it may be construed, we know that regions which are necessarily exposed to trauma and infectious agents are by nature afforded greater powers of resistance than elsewhere in the body, and the nasal mucosa is peculiarly active in this respect. While it might be supposed that the use of cocaine would obscure the etiology of these fatal cases, yet not one could be fairly stated as due to its use, though Claus gives it as the cause of his two cases (12). However, there can be no doubt but that the use of adrenalin (4) was directly the cause of several fatalities, one of which I will give later, as a personal observation at the hands of a colleague in this city. The number of authors who have testified to its dangers is great, and Lermoyez and Aubertin have tried to eliminate the peril by fixing the amount that it is safe to inject in nasal operations. Such an attempt is futile, inasmuch as an idiosyncrasy for the drug might prove fatal. The careful investigations of Lévy and Cannon and Hoskins seem to establish the fact that light chloroform narcosis (as opposed to deep) is peculiarly fatal often when adrenalin is injected, and it is so used just at the beginning of the primary stage, to save the operator a few moments' time. I have seen it so used and result in speedy death. This indefensible desire to save time would appear to be rather common, as it is given especial attention by Jacobs and other anesthetists in their articles. The absorption of many drugs, but preeminently adrenalin is very rapid when injected or even applied topically, in the nasal mucosa, in fact when injected into the turbinates, especially the middle absorption is more rapid than from any other region. Filcher has demonstrated this fact in the course of extensive experiments. The deaths that do occur from chloroform anesthesia, independently of the use of adrenalin, Lévy has shown to be due to cardiac fibrillation, and that adrenalin also can cause this same

fibrillation. Again, von Anrep and Starling have shown that the rise of blood-pressure seen in asphyxia is due to the increased amount of carbon dioxide, which in turn increases the secretion of epinephrine. To cap this climax of hazard, Cannon and Hoskins testify that fear and sensory excitation greatly increase the activity of the adrenals! How does any patient escape death who has a submucous resection done under chloroform, in the early stages of which narcosis adrenalin is injected into the septal mucosa? Certainly the operator has placed his patient's life in grave and unnecessary jeopardy.

DEATHS DUE TO ADRENALIN

1 Hubbard reports the case of a colleague in which the adrenalin was injected into the turbinate under ether-chloroform anesthesia, and death was very speedy. In the light of the preceding facts about anesthesia, it is not surprising, especially as the patient was verging on nervous prostration, which introduced a still worse complication.

2 Under the belief that the death was due to the status lymphaticus, Harris reported a case of removal of the tonsils under cocaine-adrenalin infiltration in which the death was almost instantaneous. However, in the discussion that followed the reading of the paper, Harris admitted that perhaps the adrenalin was actually the cause of the death, despite the finding at autopsy of a thymus weighing 18 grammes. In this opinion I concur, as did Swain and Hubbard most vigorously. The right heart was filled with fluid blood till the auricular appendage was five times the size of the left. Thus I am reporting the case as one in which the death was due to the adrenalin, of which he received about 8 to 10 minims, and of cocaine $1/12$ grain.

3 Freudenthal had a patient die after the injection of 10 drops of adrenalin.

4 A reputable rhinologist of this city lost a case, which he was about to operate upon for deviation of the septum, within three minutes after the injection of adrenalin. The case was that of a young man, who approached the operating room in some distress of mind, and while just barely under the influence of

the chloroform the adrenalin was applied. Almost instantly he was observed to be in distress, his breathing shallow; soon the pulse was impossible of detection, then the lungs ceased action. This case has not been published.

DEATHS FROM HÆMORRHAGE

1 I saw a patient of a colleague die from hæmorrhage of the middle meatus in the extraction of a sarcomatous tumor. He was nearly 55 years of age, and the sarcoma well developed, though it might be possible that asphyxia was the immediate cause of death, as the preliminary tracheotomy and tamponade of the larynx were not done. The blood in great quantities flowed into the lungs, as the hæmorrhage was unusually profuse owing to the method of attack employed by the general surgeon who performed that part of the operation. The floor of the nasal cavity was severed from the upper part by a horizontal incision made at the gingivolabial line, giving a free view of the growth, but adding alarmingly to the loss of blood. The case has not been reported.

2 In his paper on nasopharyngeal growths and the complications attending their removal, Sczmurlo reports the loss of one of them through hæmorrhage.

3 According to Léméré, Gerdy had a similar unfortunate experience in removing polypi.

DEATH FROM PACKING NOSE FOR EPISTAXIS

1 Hayen packed a nose with gauze saturated with a solution of perchloride of iron and saw his patient die some hours later from meningitis. The post-mortem showed this inflammatory process plainly but also showed the path the infection followed, proving that the olfactory nerve fibers do transmit infection through the cribiform plate to the meninges. The whole length of the olfactory sulcus was stained with a brown discoloration which continued throughout the nerve paths to the meninges.

DEATHS FROM PUNCTURE OR INJECTION OF AIR OR FLUIDS INTO ANTRUM OF HIGMORE

1. Neuenborn reports having seen the

death of a colleague's case from irrigation of the antrum, which he thought due to the cocaine, but the manner of the death, which was almost instantaneous, excludes this cause.

2 A patient who had had the frontal and maxillary sinuses irrigated before with no signs of distress, at the next visit suddenly collapsed, and soon died when the same procedure was attempted. Such is the report of Henrici, as given in Kelly's paper. The frontal sinus could have had no part in the fatality, as it lacks the reflex which the antrum possesses, and which I believe to be the cause of such deaths. Henrici speaks of the death as due to, or following, an epileptiform seizure, provoked by the shock of the treatment.

3 Hajek's patient was a diabetic who also had arteriosclerosis and was of advanced years. The trocar was introduced beneath the inferior turbinate and the fluid injected for the relief of an empyema. He immediately collapsed, developed a left hemiplegia and soon after died (36 hours) from cerebral apoplexy.

4 Kelly's patient complained of feeling a tickling sensation in his larynx when air was blown through the antrum, and he had an immediate paroxysm of violent coughing lying prostrate for 45 minutes. A week later, the air would not go through the ostium and he tried to force it whereupon the patient's head fell forward and he said the same tickling was present in the larynx and down the arm of that side. He then fell forward unconscious and remained so for 3 hours, when he complained of pain in the arm and leg, and the leg seemed to be convulsively twitching. He died in 14 hours.

5 In a case showing suppuration of the maxillary, frontal, and one sphenoid sinus and polypi Kelly had already removed the polyp and entered and washed out several times the antrum through the alveolar route. At this treatment he merely inflated the cavity, and was astonished to see the patient's head fall forward, and the patient become unconscious. A little later a convulsion developed and he died in 40 hours.

6 A case which Claus had twice before irrigated on the third antral irrigation sud-

denly became cyanotic and died. He incorrectly attributed this to the use of novocaine. The autopsy revealed nothing abnormal.

7. His second case died several hours after puncture of the antrum and insufflation of air, again, he wrongly gives cocaine as the cause of death. The autopsy showed minute hæmorrhagic spots in heart, lungs, and brain.

8. One hour after puncture of the antrum, Bowen lost a case, whose death he gives as due to an embolism of the pulmonary artery. This was shown at autopsy, as well as the immediate cause of it, the passage of the trocar behind the antrum, separating the periosteum from the bone and wounding the vessels there.

9. In Killian's clinic a patient died immediately upon his antrum being irrigated. Killian thought the low temperature of the injected fluid responsible for the death, as it shocked the patient.

10. Culbert punctured a patient's antrum and a septic pemphigus developed soon after. In two weeks the patient died.

The only rational explanation for the sudden deaths that occur in this connection is a reflex irritation of the vagus which can be accomplished by an irritation of the second branch of the trigeminus which supplies the antrum and communicates with the vagus. Killian, Hajek, and Félix all agree on this point, and Killian presents the additional fact that in many the irritability of the trigeminus is much greater than usual, and thus the more likely to give the reflex. Moreover, the series of experiments conducted by Kretschmer, Knobloch, and Roder seem to prove this method of heart arrest entirely possible.

DEATHS FROM PROBING AND IRRIGATING FRONTAL SINUS

1. Weigert (quoted by Vohsen, 9) reports a case of fatal meningitis due to an injury to the dura, made by an attempt to make an application to the frontal sinus. The autopsy showed that the applicator had pierced one of the sinus walls.

2. Mermod was so unfortunate as to attempt to introduce a cannula into the

frontal sinus of a hydrorrhoea nasalis case, both of whose sinuses at autopsy proved to be absent. The injury to the dura and brain caused in 6 days a fatal meningitis.

3. Forty-eight hours after the injection of an antiseptic solution in the frontal sinus, Ingals lost a patient from meningitis. He had previously opened the nasofrontal duct intranasally, and had been for a week irrigating the sinus with a mixture of hydrogen peroxide and boric acid solution. On this occasion, as the flow of pus seemed to continue profuse, he used more force than usual in an attempt to reach the deep origin. Suddenly the patient complained of pain and became unconscious. Apparently the great atrophy of all the nasal structures, which was marked in this case, extended to the walls of the sinus in the deep recess of which, over the orbital plate, was a collection of inspissated pus. This under the action of peroxide caused a sudden and violent pressure, with opening into the meninges.

DEATHS FROM REMOVAL OF POLYPI

1. Merckx's patient died 4 days after the removal of a polypus, from meningitis. He thinks there was a latent meningitis some weeks before operation, as she complained of headache and fever, and her disposition had altered markedly.

2. According to Léméré, Demarquay lost a patient from meningitis after the avulsion of a polypus.

3. Voltolini's case died from septicæmia after a similar operation.

4. Despite his care in doing the operation in several sittings, Réthi lost a patient from meningitis following the removal of several polyps.

5, 6, 7. Heymann mentions 3 deaths at the hands of reputable rhinologists in Berlin from this operation.

8. Twelve days after operation Tawse lost a case from brain abscess.

9. Broeckart lost a case similarly.

DEATHS FROM ETHMOID CURETTMENT

1, 2. Tawse lost two cases, one 7, the other 4 days after operation, from meningitis.

3. Five days after a partial curettement

of the ethmoid labyrinth, Hajek lost a patient from meningitis. The removal of the middle turbinate, which preceded this operation, had no effect in causing death, in my opinion.

4. Hinsberg lost one case from simple curettement.

DEATHS FROM TURBINATE OPERATIONS

1. Removal of the inferior turbinates resulted in death in Gregory's case, though the autopsy showed a fractured ethmoid cell, which might have caused the terminal meningitis.

2. Kummel's case died from the result of a tear of the dura and a fracture of the cribriform plate, apparently caused by the removal some time before of the middle turbinate. The injuries were not discovered till after death from what was supposed to be an acute frontal sinus abscess. The autopsy revealed the basic trouble and cause of the cranial involvement.

3. The danger of removing the entire middle turbinate in acute frontal sinusitis without first trying the ordinary irrigation is illustrated by the death in the practice of a colleague of this city. The advanced age of the patient made her an especially bad risk, but the ethmoid disease under the middle turbinate soon flared up into an acute inflammatory process and she died in 4 days from meningitis. There was an external opening made into the frontal sinus, but the operation on the turbinate caused the trouble.

4. The resection of the anterior end of the middle turbinate caused a meningeal death in Merker's case, as reported by Boenninghaus.

5, 6. The classic cases of Quinlan and Wagner, each of whom lost a case from galvano-cauterization of the middle turbinate are well known.

7, 8. R  thi, however, adds to the records a case of Lange and another of Lublinski, died from the same cause, meningitis following galvano-cauterization of the middle turbinate.

9. My own case unpublished thus far, was particularly unfortunate, as it was an operation of choice and one in which so little was done that the death was as shocking to me as to the family of the patient. Under ether, because of his extreme nervousness,

the right inferior turbinate was resected, only to the extent of the inferior edge, about one-third of the bone being removed antero-posteriorly. In addition, with the forceps the remains of adenoid tissue were removed, a small centrally located, fibrous mass as large as the tip of the little finger. He took the ether very badly, and never regained consciousness after its administration, passing into violent convulsions the next morning and later lapsing into coma, dying the third day from cerebro-spinal meningitis. A few moments after death, a thin stream of cerebro-spinal fluid trickled down the upper lip, having escaped from the cribriform plate on the side operated upon. That the patient should never have come out of the ether, but passed insensibly into the unconsciousness of meningeal infection, and that this infection should have followed so insignificant an operation as indicated, strongly suggests that the patient already had a latent meningitis at operation.

DEATH FROM EXPLORATION OF THE SPHENOID SINUS

1. Emerson's attempt to curette the sphenoid sinus ended in death, because his instrument injured a vein which communicated with the cavernous sinus. A dehiscence in the lateral wall of the sinus exposed the vein to this unexpected injury.

DEATHS FROM RESECTION OF THE NASAL SEPTUM

1. Eight days after operation Hays' patient died from meningitis.

2. Alexander also lost one in a similar way.

3, 4. Miodowski's first case died in five days after operation, the second developed erysipelas on the fourth day, and died from meningitis on the sixteenth day. In the latter case infection was traced through the olfactory tract.

5, 6, 7. A reputable rhinologist of this city lost three cases from meningitis through no fault of technique or after treatment. nor was there any pus in the nose at operation. These cases have not been reported. 8. However there was frank pus in the nose of this case as it was due to a desuppurative ethmoiditis, and the death

meningitis which followed in five days was neither surprising nor to the credit of the operator, a man of reputation in this city. It need hardly be stated that the case has not been reported.

9 A colleague in this city quite recently lost a case from cerebrospinal meningitis in a week after operation. A decompression operation was done, which seemed to relieve the symptoms for a day. The infection was through the cribriform plate. The case has not been reported.

I wish to make especial acknowledgment of my debt to Dr Eugène Félix, whose thorough paper and comprehensive bibliography have been of the greatest value. I have followed both rather closely, and have, I hope, been able to add somewhat to the number of cases and of observers.

That the interior of the nose is both theoretically and practically a zone of considerable danger for even the slightest instrumental interference I hope I have shown; and that the indiscriminate use of adrenalin is similarly fraught with danger in this region, when used for operative assistance, can be no longer ignored.

REFERENCE

- 1 FÉLIX, E. Die Mikroorganismen der normalen Nasenhöhle. Wien med Wchnschr, 1903, Nos 14 and 15.
- 2 WÜRZ and LERMOYER. Le pouvoir bactériode du mucus nasal. Ann d mal de l'oreille, du larynx, Par, 1893, p 661.
- 3 THOMSON, ST CLAIR, and HEWLETT. The fate of micro-organisms in inspired air. Lancet, Lond., 1896, p 86.
- 4 PARK, W H, and WRIGHT, J. Tr Am Laryngol Ass, 1897.
- 5 FÉLIX, E. L'emploi de l'adrénaline dans les affections du larynx, etc. Ann. d. mal. de l'oreille, du larynx, Par, 1904, March.
- 6 LERMOYER, M., and AUBERTIN, Ch. Les effets toxiques de l'adrénaline de la muqueuse nasale. Ann d mal de l'oreille, du larynx, Par, 1909, p 290.
- 7 HUBBARD, T. Tr Am Laryngol Ass, 1909, pp 165-170 (Discussion).
- 8 FREUDENTHAL, W. Die Gefahren der Localanästhetica und Nebennierenpräparate bei ihrer Anwendung in der Rhino-Laryngologie. Zentralbl f Laryngol, 1910, p 247.
- 9 VORSEN. Zweite Versammlung süddeutscher Laryngol. Münch med Wchnschr, 1895, p 707.
- 10 MERMOD. Méningo-encéphalite consécutive à l'exploration d'un soi-disant sinus frontal. Ann d mal de l'oreille, du larynx, Par, 1896, No 4.
- 11 INGALLS, F. Intranasal drainage of the frontal sinus. J Am. M. Ass., 1908, May 9.
- 12 CLAUS. Vier tible Zufälle, darunter zwei mit tödlichem Ausgang, bei der Punktion der Oberkieferhöhle. Beitr. von Passow, 1910, IV, 88.
- 13 BOWEN, F M. Two cases of air embolus follow exploratory puncture of the antrum of Highmore. Ann Otol, Rhin, & Laryngol, 1913, March.
- 14 KILLIAN, G. Verhandlungen des Vereins deutscher Laryngologen XX Tagung Monats. f Ohrenh, Berl, 1913, p 1260.
- 15 CULBERT, L W. Report of a case of chronic suppuration of the antrum of Highmore, etc. Laryngoscope, St Louis, 1910, p 824.
- 16 KRETSCHMER. Sitzungsh d k Akad d Wissensch, Wien, 1870, p 530.
- 17 KNOBLACH and RÖDER. Experimentelle Untersuchungen zur reflectorischen Herzrhythmus. Arch f d gesamt Physiol, cxv, 136.
- 18 HAJEK, M. Ein Beitrag zum Studium des Infektionssweges bei der rhinogenen Gehirnkomplikation. Arch f Laryng u Rhinol, Berl, 1906, xviii, 290.
- 19 MERCKE, J. Ann d mal de l'oreille, du larynx, Par, 1906, p 109.
- 20 KUMMEL. Verhandlungen des Vereins deutscher Laryngologen xx Tagung Monats. f Ohrenh, Berl, 1913, p 1254.
- 21 BOENNINGHAUS. Handbuch der speziellen Chirurgie des Ohres und der oberen Luftwege de Katz, Preysing und Blumenfeld, 1911, III, 203.
- 22 QINLAN, F J. A case of electrocauterization of the middle turbinate bone followed by meningitis. J Respiratory Org, 1890, June.
- 23 WAGNER, R. Erkrankungen des Hirns nach einfachen Nasenoperationen. München med Wchnschr, 1891, No 51.
- 24 LANGNOIS. Ann d mal de l'oreille, du larynx, Par, 1903, II, 489.
- 25 RÉTHI, L. Ueber Zufälle nach Nasenoperationen. Arch f Laryngol, 1896, IV, 403.
- 26 LÉMERÉ. Sur les accidents consécutifs à l'arrachement des polypes des fosses nasales. Thèse de doc, Paris, 1877.
- 27 VOLTOINI. Die Krankheiten der Nase. Breslau 1888, p 237.
- 28 HEYMANN, P. Handbuch der Laryngol u Rhinol. Wien, 1900, III, 836.
- 29 TAWSE, B H. Some complications and dangers of nasal surgery. Lancet, Lond, 1909, p 1582.
- 30 BROECKART. (Quoted by Boenninghaus, vide 21.)
- 31 DAVIDSON. Zentralbl f Laryngol, 1904, p 420.
- 32 HINSBERG. Verhandlungen des Vereins deutscher Laryngologen xx Tagung Monats. f Ohrenh, Berl, 1913, p 1255.
- 33 GREGORY, H L. A case of acute cerebrospinal meningitis of nasal origin. J Laryngol, Rhinol & Otol, 1912, October.
- 34 EMERSON, F P. Absence of the outer right sphenoidal wall etc. Ann Otol, Rhinol, & Laryngol, 1908, June.
- 35 HAYS, H. Two cases of septicaemia following submucous resection of the nasal septum. Am J Surg, 1909, November.
- 36 ALEXANDER, H. Complications following the submucous operation upon the nasal septum. N Y. M J, 1911, October 14.
- 37 MIODOWSKI. Ztschr f Laryngol, 1912, V, 943.
- 38 SCHWALBE. Der Arachnoidealraum. Med chir Centralbl, 1869, p 465.
- 39 MICHEL. S. Bericht der sächsischen Gesellschaft der Wissenschaften, 1872, p 331.

- 40 KEY and RETZIUS *Studium in der Anatomie des Nervensystems und des Bindegewebes* Stockholm, 1875, I, 217
- 41 CUVÉO and ANDRÉ *Bull et mém de la Soc anat.* Par. 1905 VII, 6 e série, p 58 Marc André, Contribution a l'étude des lymphatiques du nez et des fosses nasales Thèse de doct., Paris, 1905
- 42 FÉLIX, F. *Accidents mortels a la suite d'interventions intra nasales Arch Internat de laryngol, d'otol et de rhinol.* 1914, XXXII No 1.
- 43 TURNER, A. LOGAN *Archiv f Laryngol*, 1911, XXV, 270
- 44 SZYMURLO, JAN The so-called nasopharyngeal polyp and treatment *Ztschr Laryngol, Rhinol.* etc., Würzburg, 1915, VII, 473
- 45 KELLY, A. B. *J Laryngol, Rhinol, & Otol*, London, 1914, XXIX, 556
- 46 CLARK and CATHCART *Glasgow M J*, 1914, April, 269-274
- 47 CLARK and CATHCART *J Physiol*, 1913, XLVII, 393
- 48 HAYEN Quoted in paper of Logan Turner, q v. (43)
- 49 LÉVY *The Heart*, 1913, IV, 319
- 50 VON ANREP and STARLING *J Physiol* 1912, XLV, 307
- 51 CONNER and HOSKINS *Am J Physiol*, XXIV, 274
- 52 NEUBERG *München. med. Wchnschr.* 1907, August, p 1653
- 53 HAJEK *Verhandl d. deutsch. laryngol. Gesellch., Würzburg* 1908 p 163
- 54 KILLIAN *Verhandl. d. deutsch. laryngol. Gesellch., Würzburg*, 1913 p 217
- 55 HENRICI Quoted in paper of A. B. Kelly, q v. (45)
- 56 GERRY Quoted by Lémere, q v. (26)
- 57 SWAIN *Tr Am Laryngol Ass*, 1909, p 165 (Discussion)
- 58 HARRIS, T. J. *Ibid* pp 165-170

SOME FEATURES OF IMPORTANCE IN THE DIAGNOSIS AND PROGNOSIS OF UROGENITAL TUBERCULOSIS

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IN order to emphasize the importance to the urologist of viewing the bladder and deep urethra as practically a common organ, and of accentuating the intimate interrelation of the various urologic developmental centers from an anatomic and a pathologic standpoint, the accompanying illustrations are herewith presented.

Quite recently the anatomists have shown us the close association of the lymphatic system of the kidney with the ureter, of the ureter in its turn with the bladder, and of the latter with the deep urethra. The illustrations in this communication will, I think, corroborate this close association, at least in so much as it concerns tuberculosis.

The drawings were made with the aid of a straight urethrocystoscope, constructed for me by Mr. Rhinold Wappler, who has incorporated in the instrument an unique lens system, which permits of close observation with a minimum of distortion. It affords a truer picture than any similar instrument that has up to the present come under my observation.

Figure 1 shows a part of the deep urethra of a young man presenting himself with an apparently recent case of tuberculous epididymitis. The deep urethral picture reveals

three dilated prostatic ducts, from one of which caseous pus exudes, while the other two ducts apparently intercommunicate. In other words there is evidence of caseous degeneration in the prostate.

Figure 2 is more typical because it shows a more advanced tuberculous degeneration in the prostate of a man twenty-four years old suffering from tuberculosis of the right kidney with invasion about the ureteral mouth of the same side.

Figure 3 was taken with the Gerringer direct telescopic urethroscope, and is introduced here because of the beautiful manner in which the bullous oedema of the floor of the bladder is seen extending into the deep urethra of a case of advanced urogenital tuberculosis.

Figure 4 is the most beautiful illustration of urethral tuberculosis observed by me. It was discovered in a patient referred for operation for tuberculous epididymitis, but because of the deep urethral picture, this was refused and instead a change in his environment advised. From a clerical position in the city he moved to the country, where after an outdoor life of two years, he shows a marked gain in every aspect, and is symptom free. The deep urethral picture in this case impresses me with the folly of operative proced-



Fig 1

Fig 2

ures of whatever character for tuberculous epididymitis without the most painstaking investigation of the deep urethra

Figure 5 has taught me the fact, at least from a prognostic standpoint, that a patient suffering from renal tuberculosis may also be in the possession of a deep urethra that will amply repay the time spent in its observation. This is the case of a young man twenty-two years old, referred for treatment, whose chief complaint was mictional frequency, both diurnal and nocturnal, whose urine was macroscopically turbid, whose case had been considered as renal tuberculosis by one urologist and by another equally competent specialist, as non-tuberculous in character. The urine was searched many times for tubercle bacilli with negative result. The bladder picture was normal, save for a moderate amount of tumefaction about the left ureteral mouth together with slight mucosal injection. Catheterization of the opposite ureter yielded urine that was normal. The left ureter was occluded at least to the passage of an ureteral catheter.

Here parenthetically I should like to state that in a young man with a history of marked frequency, a certain amount of dysuria, an urine that is macroscopically turbid, that microscopically contains pus, whose ureter is occluded who is radiographically negative, in all human probability, we have to deal with a case of renal tuberculosis. Inspection of this patient's deep urethra revealed tuberculous focal necrosis of a pronounced character. To the left of the verumontanum there was a well defined area of caseous destruction of the prostate while to the right was a number of enormously dilated prostatic ducts.

On the strength of these findings, the pa-

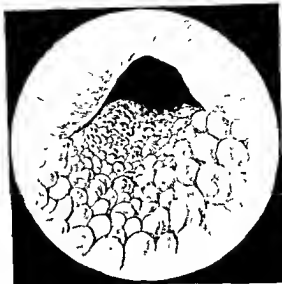


Fig 3

tient's left kidney was removed, and found to be in a well advanced state of destruction from tuberculosis. Following the operation the patient was sent to the country where he remained for about eight months. He returned, the picture of health, reported a gain of twenty pounds in weight, and stated he was symptom free. Cystoscopic examination was negative. The pathologic change previously reported as seen about his left ureteral mouth had completely disappeared. Had his examination at this time been limited to an inspection of his bladder, the patient's report, his general appearance, the physical characteristics of the urine, he would in all probability have been discharged as a cured patient. His deep urethra, however, gave evidence of little or no improvement from



Fig 4

Fig 5

the time of the first examination. The patient, therefore, was advised to remain permanently in his new environment.

The above studies sufficiently demonstrate the fact that any instrumental examination in a case of suspected urogenital tuberculosis, is incomplete without the most careful investigation of the deep urethra. This step is important from the standpoint of diagnosis, prognosis, as well as operative indication.

In conclusion, I desire to lay stress upon the fact that operative procedures for tuberculosis on any part of the urogenital tract must ever be considered as merely the primary step in the treatment of the disease, that the operation should be looked upon perhaps as removal of the chief focus of the disease, but not in itself as a curative measure, that preliminary immunization should not be overlooked, but that above all else the patient should be considered as constitutionally a tuberculous subject, and treated as such.

Finally, in line with this idea, the time has come when the authorities should busy themselves in the organized care of "surgical" tuberculosis. For, to say to a tuberculous subject, which in effect is what the State does, "You must exercise a selective action in affording a domicile to the tubercle bacillus,

inasmuch as there is no provision for you unless we find the germ in your lungs," would be laughable were it less tragic. The State should know that the least remunerative form of tuberculosis, from the economic standpoint, is the frank pulmonary type. It should also bear in mind that every "surgical" tuberculous subject is potentially a menace to his neighbor, for the reason that at any time his disease is likely to become transmissible. It should also realize that the presence of "surgical" tuberculosis, is in itself an indication of the subject's ability to focalize the disease, and all that is needed in many cases is an additional push in the form of appropriate climate, diet, etc., effectually to surmount the difficulty.

It seems therefore, the bounden duty of the city, state, and nation to correct this paradoxical situation by vitalizing the movement recently inaugurated in New York City, by Dr. John Winters Brannan, whereby the non-operative as well as the post-operative tuberculous patient is given the benefit of such sunlight, such air, such food and such environment, as will give our people, not only the satisfaction of an humanitarian work well done, but will also in many cases convert potential wrecks into whole citizens.

ENLARGED THYMUS IN INFANCY

BY J. T. HERRICK, M.D., F.A.C.S., OTTUMWA, IOWA

ENLARGEMENT of the thymus gland is directly or indirectly the cause of a number of deaths. The chief symptoms during life are those of obstruction to respiration.

The upper part of the chest is encroached on behind by the spine and in front by the sternum, so the organs occupying the cavity may easily be subjected to pressure of hypertrophy of the thymus. It seems difficult to understand how the trachea, which is quite resistant because of its cartilaginous rings, should suffer compression while the non-resisting veins and the arteries are supposed to escape. May not the symptoms be partly due to pressure on other organs than the trachea?

The form of the thymus and its location varies. The original development from two separate lobes is usually evidenced by the lower pole being divided, one tongue to the right and another, often the largest, to the left. These may extend down to, and overlap, a portion of the pericardium.

The essential symptom of thymic enlargement is a respiratory disturbance simulating a foreign body in the trachea. The respiratory difficulty may manifest itself in all possible grades, from a mild stridor to a very severe dyspnoea with fatal termination. There is a difficulty in both inspiration and expiration, but the stridor seems more intense during inspiration, at least in the cases seen by the writer. In certain cases the difficulty seems lessened by lying at an angle of about twenty-five degrees as in one of the cases reported below. In others it seems as if the upright posture was most comfortable. In some cases after a fit of vomiting, coughing or crying during which the stridor is exaggerated, there are a few minutes' relief. In one case emetics were given for a time during an exacerbation which lasted two weeks because after each vomiting spell a short respite was given from the severe croup from which the child was thought to be suffering.

In more serious cases the exacerbations are very severe, even just short of death. These cases often manifest asthmatic features, and often in some violent attack death comes to the relief of the little sufferer. Death may result in the first seizure, or it may come only after months of recurring attacks and even after there has been an apparent improvement.

As to the immediate cause of death, most authors attribute it to pressure on the trachea; but pressure on the vagi, the vessels, and the heart are assigned as causes. In one of the following cases there is good reason to believe that pressure on the right auricle was the chief factor.

Differentiation of the stridor of enlarged thymus from that due to a foreign body may be made by the history of a more gradual onset, slowly increasing trouble, absence of X-ray evidence of foreign body, and the presence of dullness to side of sternum, and positive evidence of enlarged gland in X-ray shadow. The differentiation from croup may usually be made by careful examination of the throat and the failure to relieve by intubation.

It is very difficult, if not impossible, to make a diagnosis between enlarged thymus and great enlargement of the mediastinal glands. The dullness in enlarged thymus is usually higher up with a notch between it and the heart area, while dullness from lymphadenitis is near the bifurcation of the trachea and great vessels. A skiagraph may assist. Also the thymic case is usually well nourished but pale and pasty, with no tubercular history. The tubercular case may be reduced in flesh, less vigorous in appearance, and may have slight elevation of temperature, all of which are absent in an uncomplicated case of pure thymic stridor.

On the question of treatment there is no very settled opinion. Extirpation is both dangerous and uncertain, especially in children. The X-ray appears to be the safest and most



Fig 1 Case 1 The above is a photograph of the removed thymus superimposed on a plate of the heart and vessels. The relations are correct except that the upper pole extended somewhat higher into the neck. Not being supported by connective tissue, as was that overlying the pericardium it shrunk very much on removal. (Plate from Deaver's Surgical Anatomy)

satisfactory method. The following cases may be of interest and are therefore reported.

CASE 1. Male, age 1 year, seen in consultation, February, 1909. Several days before while playing on the bed with its father the child became quite excited and began to breath hard. As the condition continued a search was made for a cause and a small bone button was found to be missing from the father's sleeve and it was decided that the child had swallowed the button. A physician was called but attributed the trouble to croup. The child did not improve hence the consultation. A good skiagraph showed no evidence of foreign body in the air passage but did show a widening of the shadow of the sternum which with the symptoms present—stridor cyanosis retraction of abdomen and suprasternal spicc—absence of fever, etc.—led to a diagnosis of enlarged thymus. The case was treated symptomatically the condition not seeming very serious and on the approach of spring and warm weather it became well enough to pass out of the care of the attending physician. The family moved in the meantime, and in October, 1909, the child was again brought to the office for consultation this time by another physician. The writer



Fig 2, Case 2 Shows shadow to right of sternum as indicated at X. (Slightly retouched)

recognized the case and felt convinced of the truth of the former diagnosis. However, at the urgent request of the attending physician and the parents, skiagraphs were taken showing no evidence of a foreign body in the air passages.

The diagnosis of enlarged thymus being confirmed, as was believed and the writer refusing to operate, the child which was getting worse all the time was taken to Chicago. Notwithstanding the fact that no foreign body was shown by the X ray and that a diagnosis of enlarged thymus had been made, the symptoms were so characteristic of foreign body that tracheotomy was advised by two prominent surgeons.

The child was anesthetized but on the first incision for tracheotomy, stopped breathing and could not be resuscitated. No foreign body was found. The writer was permitted to make a post mortem examination, which showed a very large thymus reaching from above the sternum down to and covering fully one third of the pericardial sack as indicated in the illustration, Fig 1.

The right lobe of the thymus was especially thick and fleshy and lay directly over the right auricle. The left lobe somewhat longer, but not so thick, lay across the root of the large vessels. The attachment to the pericardium was so intimate that it was impossible to dissect it loose and in removing the gland a large area of the pericardium had to be removed. At no place was there any evidence of former narrowing of the trachea or bronchi as a result of pressure. The body of the gland lay in direct contact with the trachea for about one and one half inches from the upper pole. From there down the trachea dipped decidedly backward behind the root of the great vessel so that it would have been impossible to have pressure at this point without transmitting it through the veins and arteries which are less resistant than the trachea even though they are sustained by the blood pressure within.

The post mortem diagnosis of the cause of death



Fig 3. Case 4 Shows marked enlargement of the thymus extending to right of sternum as indicated



Fig 4. Case 6 Widening of the sternal shadow to the left as indicated at X

was Pressure on the right auricle and probably also on the large veins about the base of the heart

In this case any attempt to remove the gland through an incision in the neck would have failed on account of the extensive and intimate attachment to the pericardium. An effort at removal accompanied by traction on the gland, as has been recommended, would probably have proved immediately fatal through disturbance of the cardiac reflexes

CASE 2 Florence K., age 3 years, 7 months, seen in consultation, August 20, 1912 The following notes were made at time of first examination "Well nourished, fair complexion, blue eyes, good appetite sleeps fairly well In March 1912, when three years old the child was first noticed to have what was thought to be a cold, breathing somewhat croupy, slight hoarseness There was no improvement under treatment and the patient gradually became worse The symptoms were not severe, however until August 25 1912, since which time the trouble has been decidedly worse Examination shows a child as above, with marked respiratory stridor, worse on inspiration, especially noticeable under excitement, marked retraction of epigastrium and suprasternal space, except when perfectly quiet then only moderate There is a strong blowing sound on either side, back and front, over trachea and large bronchi, especially loud in region of bifurcation no consolidation of lungs, no moist rales but some wheezings sounds over both lungs The heart is normal, the area of dullness apparently normal but extends a finger breadth in width up to the clavicle on right of sternum The lymphatic glands of the neck are slightly enlarged Laryngoscopic examination revealed nothing The child could not be kept quiet for a good picture and

we were afraid of an anæsthetic (see Fig 2) Diagnosis Enlarged thymus, no history of foreign body and no family or personal history bearing on the condition "

X ray treatment was advised Two attempts were made to give such treatment within a week, but owing to the resistance of the child they were unsatisfactory Ten days after the consultation the child died in an acute attack No post mortem was permitted Personally I have no doubt as to the diagnosis

CASE 3 Baby G., born March 1912, seen in consultation, September 22, 1912 She seemed perfectly normal at birth, grew in weight and strength until two and one half months old, when the present trouble began The first thing observed was a slight inspiratory sound especially when excited or crying This very slowly increased in severity although the child seemed perfectly well, grew fat and strong without disturbance of pulse or temperature While on a visit to the country, in July, the baby developed a violent attack in which it seemed it must die The acute trouble lasted two weeks and did not seem to be at all affected by treatment The temperature remained normal On partial relief from the severe symptoms the baby was brought back to town continuing to suffer as strided She had never been sick of any other disease When seen by the writer, September 22, the baby then six months old was normal in size, bright, interested in surroundings, in fair flesh, somewhat pale, and suffering from difficult breathing There was marked inspiratory stridor with retraction of the suprasternal space and of the epigastrium This had continued so long that there was a noticeable deformity of the chest There was bronchial breathing over both lungs with crowing sound especially on inspiration No dullness on percussion or moist rales detected

The heart was about normal in size, but the dull-

ness as in the other cases extended up to the clavicle on the left, being about the width of a finger in breadth. A skiagraph was only a partial success because of difficulty in quieting the child. The father and mother were healthy, no tuberculosis in family except two half aunts. The child had never been about tubercular persons. The lymphatic glands were apparently normal.

Diagnosis Enlarged thymus

The father was a socialist who was certain the doctors were trying to fleece him so refused to let the child be treated by the X-ray as recommended. The child was living two months later but in very bad condition. The family moved away about that time.

CASE 4 G M, male, age 4 weeks. Infant was apparently normal at birth. A trained nurse in attendance for two weeks noticed nothing unusual about the baby, nor had the attending physician. The mother, however, thought there was some respiratory disturbance from the first. During the third and fourth weeks there gradually developed a respiratory difficulty which culminated, April 21, 1914, in a violent attack of dyspnoea during which the baby almost perished. Examination showed a well nourished infant, temperature and pulse normal. No evidence of disease of the lymphatic glands or other structures on inspection. Physical examination of the chest showed very pronounced sonorous and sibilant rales over all of both lungs. There was marked respiratory stridor. Marked retraction of supraclavicular and intercostal spaces and of epigastrium during inspiration, with long and labored expiration. The breathing could be heard all over the house. A skiagraph (Fig. 3) showed an enlargement of the thymus to the right. The first severe attack proved almost fatal.

A number of severe attacks followed during the week but were of diminishing severity, apparently as a result of treatment. X-ray treatment was instituted immediately after the first severe attack. The rays were filtered through one millimeter of aluminum and one thickness of wet sole leather. The dose was about one fourth erythema dose as measured by the Holzknecht radiometer. The anterior and posterior walls of the chest were treated alternately. A treatment was given every day, the first week, then every second or third day. Later two treatments a week. In all twenty treatments were given. There was improvement from the beginning. After the first week there was no severe attacks and the child was comfortable with very little difficulty except when crying. Recovery seemed complete and has continued so until now, 16 months after treatment was started. No skiagraph was secured after the treatment was begun.

CASE 5 Louise A., age 8 months, seen first July 6, 1914. The child was well nourished and apparently well in every way except for difficult breathing, temperature and pulse normal. She had no sickness since birth. Family history good.

No enlarged lymphatics no evidence of swelling or tumor in neck. When she was one week old there was noticed a slight "wheezing" sound on inspiration. This gradually grew worse until it became very distressing. It was aggravated by fretting, crying, or slight colds. While there were severe attacks at times, the child did not appear in immediate danger of suffocation. The parents stated that no treatment so far tried, had benefited the patient. On examination there was marked respiratory stridor, with pronounced retraction of the supraclavicular and intercostal spaces and of the abdomen. Sibilant rales were present over both lungs. No dullness could be detected except to left of sternum where the cardiac dullness seemed to extend upward to the clavicle. A skiagraph also showed a shadow in this region, but not distinct enough to print.

Treatment was given as in Case 4. Very little improvement could be noticed until eight treatments were given, from which time improvement was continuous, recovery was complete. Five months after the treatment was discontinued, the patient remained perfectly well. In all, there were twenty-two treatments.

CASE 6 Baby D., male, age 2 months, gives the following history. Born about July 15, 1914. In every way he seemed strong and healthy except that within a few days there began to develop slight difficulty of breathing. At first it was thought to be due to cold. The temperature and pulse were normal during the entire time. The breathing became more and more difficult, with exacerbations resulting from fretting or crying. No treatment was of avail.

On examination the baby was found to be strong, healthy, and well developed. In fact a more healthy looking child would be hard to find except for the difficulty with respiration. There was slight stridor, with retraction of the spaces and abdomen on inspiration. There were sonorous rales over both lungs, and a disinclination to active movements. The trouble was markedly aggravated by crying. The lungs were resonant except for slight dullness to left of sternum above cardiac area. A skiagraph showed a shadow in the same region (see Fig. 4). A diagnosis of enlarged thymus was made and X-ray treatment instituted as in Cases 4 and 5. The improvement was continuous from the first. When the last treatment was given, November 18, 1914, there was no stridor nor could any rales be found in either lung. The dullness to left of sternum was reduced. In this case thirty exposures were made. As in Cases 4 and 5, there has been no return of the symptoms and all three patients are well at this writing, August 1915.

Reviewing the six cases the first case was one of enlarged thymus as proved by its clinical history and the post-mortem. In this case the diagnosis was made six months before the death of the child. In the second

case an equally clear history together with the sudden death, even in the absence of a post-mortem, is conclusive as to the correctness of the diagnosis. The third case has an equally convincing clinical history of enlarged thymus, and while living when last heard from seemed in imminent danger of death. It had no treatment.

The result of treatment in Cases 4, 5, and 6, tend to confirm the diagnosis. The diagnosis was made primarily on the history, the physical findings, and by the skiagraph. Judging by the results in Cases 4, 5, and 6, the X-ray is a safe and effective means of treatment. Larger dosage would produce a more

prompt result, but the method employed was thought to give better control of the action of the X-ray.

The cases ranged in age when first seen from four weeks to three years, the average being eleven months. There were two cases in which the first symptoms appeared at one week after birth, one at two weeks, one at two and one half months, one at one year, and one at three years.

Two of the six died with practically none except symptomatic treatment. One was living under symptomatic treatment but in very bad condition when last heard from. Three were treated with the X-ray and are well

COMPRESSION FRACTURE OF THE LUMBAR VERTEBRÆ

A REPORT OF SEVEN CASES

By JAMES WARREN SEVER, M D, Boston

COMPRESSION fractures of the vertebræ occur generally following severe violence, usually a crushing force, applied through the long axis of the spine or while the spine is flexed. Four of the cases to be reported were the results of industrial accidents, while the others resulted from other accidents not industrial, but not uncommon ones. Four cases occurred in my own practice, two are cases of Dr R. W. Lovett and one a case of Dr J. S. Stone, to whom I am indebted for the privilege of reporting them. The condition was rather forcibly brought to my attention by seeing two cases on consecutive days. One was diagnosed as Pott's disease, and one as back strain. The X rays showed definitely the character of the lesion.

OCCURRENCE

The frequency of compression fractures of the spine varies directly with the different elasticity of the different regions of the ver-

tebral column. The elasticity of the spine depends largely on the intervertebral discs, and it varies directly with the relative thickness of these discs, so that the most frequent site of injury would be in the dorsolumbar and lumbar region. Fractures of this type occur as a rule only in those portions of the vertebræ which have a supporting function, that is, the bodies. The bodies may be crushed or flattened evenly, more on one side than the other, and more in the anterior portion than the posterior, depending on the direction of the application of the crushing forces. As a rule they are more compressed anteriorly than posteriorly. More than ordinary violence may also lead to a lateral displacement of the spine as a whole above the site of the injury.

Indirect force may produce a fracture and cause displacement of the fragments of the vertebræ, so as to compress the cord or divide it. Falls on the buttocks, shoulders or back or landing on the feet from a height, combined with extreme flexion or hyperextension of the trunk, are adequate methods for producing



Fig 1 X-ray, Case 2 shows the fifth vertebra crushed and crowded to left side in relation to sacrum

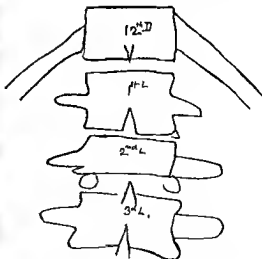


Fig 2 X-ray tracing, Case 3, shows crushing of the body of the second lumbar vertebra



Fig. 3. X-ray, Case 5, showing compressed fracture of the fourth and fifth lumbar vertebrae, with lateral displacement of the fourth and fifth so that spine as a whole above injury, is carried to the left



Fig. 4. X-ray, Case 6, showing crushing injury of the second and possibly the first lumbar vertebra

such a condition. When several vertebrae are crushed a kyphos may exist, but may or may not when only one body is injured. Three cases in this series presented rather marked kyphoses of different types following the crushing of but one body.

The cord, ending as it does at about the level of the first lumbar, is apt to be uninjured. Edema and hæmorrhage about it may lead to temporary paralysis from pressure, but the symptoms from this usually clear up soon. In case the cauda equina is crushed or injured we might reasonably expect a partial regeneration of the nerve-roots, the physiological and histological evidence of such power of regeneration being strongly in its favor.

CASE 5. E. C., male, age 23. Injured by a fall of about twenty-two feet in October 1910. He landed on his feet on a concrete floor, and then fell over on to his side. He was able to get up on to his feet and walked to his home some distance away, being helped by a friend. On reaching home he had to sit down because of weakness in his legs. He went to bed where he stayed for three weeks. During this period he had several physicians, all of whom gave him pills but no physical examination. He had no bladder or rectal incontinence, he was able to move his legs freely at all times, and his sensation was unimpaired.

He complained of considerable pain in the back, especially on attempting to turn in bed. He was

able to get about eventually with a cane, but had considerable difficulty on account of a fracture of the cuboid bone of one foot, sustained at the time of the fall. When I saw him, three months after the accident, he complained of inability to stand up straight without having pain in the lower part of the back. He also stated that he got easily tired after standing or walking. He could not sit up straight in a chair.

Physical examination showed a short, well-developed and nourished man. He stood in a slight stoop position, and walked with a slight limp of the left leg. The back showed a slight lateral curvature, convex to the right in the thoracic region and convex to the left in the lumbar region. There was tenderness on pressure over the lumbar vertebrae, beginning at the first lumbar vertebra. The spinous process of the first lumbar vertebra was slightly more prominent than the others but not to an abnormal degree. There was no tenderness on pressure either side of the spinous processes, over the line of the transverse processes on either side. The motions of the back in forward bending were guarded and stiff, and he could not bend forward more than about 60 degrees from the vertical. Side bending was about normal. In picking objects up from the floor he exhibited a condition of the spine commonly seen only in tuberculosis of the spine and due to injury or disease in the vertebrae. He had great difficulty in lying down on the floor and in getting up. There was a slight backward bowing of the spine at about the region of the first lumbar vertebra, which may have been caused by a slight increase of the normal forward lumbar curve. The reflexes were normal, and the sensation over the



Fig 5 X ray, Case 7, showing crushing injury of first lumbar vertebra

trunk and legs was normal. X rays taken showed a crushing together of the bodies of the second and third lumbar vertebrae besides a fracture of the transverse process on the right of the first lumbar vertebra.

This man was evidently practically incapacitated from doing any further hard laborious work, such as he had been accustomed to do, and needed a definite and adequate support to his back. Such a support, either a jacket or a brace, would have made him much more comfortable and enabled him to do some work. It was surprising that he had no more pressure symptoms on his cauda equina than he had, for the extent of his fracture must have caused considerable hemorrhage and edema.

CASE 2 L P, age 20. This patient was caught under an electric car on July 2, 1910, and doubled up. He stated that in an attempt to back the car off him he felt something give way in the lower part of his back and he lost consciousness at once. He was taken to a hospital where he stayed a week, and then home, where he stayed in bed for two months. He then began to sit up in bed and in a chair, and later began to walk with crutches. Since June, 1911, he has walked with a cane. On moving he occasionally feels a click in the lower part of his back which causes pain but its occurrence is becoming less frequent. He has had no paralysis of the legs, and no involvement of the bladder or rectum.

Physical examination showed a young colored man, under sized and not robust. He walked with

a slight and varying limp on the right, and could walk without a cane. He could go up and down stairs freely. The spine showed a slightly exaggerated hollowing just above the pelvis. He had a rather marked right dorsal left lumbar scoliosis. Side bending and rotation of the spine were not specially restricted. The forward bending was sufficiently free to allow reaching to within an inch of the floor without bending the knees. There was, however, a peculiar click in the lower part of the spine, produced usually by straightening the spine after it had been bent forward or backward. This click was to be heard plainly, but by touch could not be definitely located. The reflexes were normal. There was no impairment of motion or sensation.

The X rays (see Fig 1) showed that the fifth lumbar vertebra had been crushed and crowded to the left side in relation to the sacrum. They also showed that the periosteum had been torn off at one side of the spine in two places, and from these two pieces a little new bone had formed in the muscles to the left of the spine. There was no evidence of any injury to or pressure upon any of the nerves.

The man was seen about two years after the accident, and it was considered that he had made a very good recovery, but it was deemed doubtful if he could ever do heavy lifting again without starting up some irritation in the back. His functional recovery otherwise is good. He had had at no time any support to his spine, but undoubtedly would have been more comfortable had he had one.

CASE 3 H C man age 26. On October 7, 1914, while working on the limb of a tree the limb broke and he fell about fifty feet to the ground. He was made unconscious and remained so for several hours. He was taken to a hospital where he stayed two weeks in bed. He was then taken home, and stayed in bed two more weeks when he began to walk about. For the past four months, that is, until February, 1915, he has been wearing a light, untempered, spring back brace. At the time of the accident he also fractured one wrist and some of the carpal bones. He apparently has had no diagnosis made of his condition up to the present. He never had any loss of control of his bladder or rectum, and had no impairment of his motions or sensation. He complains at present, that is four months after the accident of severe pain in the back on getting out of bed in the morning. This pain lasts for some time, and returns on walking, becoming finally so severe that he has to lie down. He wears his back brace during the day but leaves it off at night. Otherwise he appears to be in good condition.

Examination of the back shows that there is a small kyphos involving practically three vertebrae in the dorsolumbar region. This kyphos the patient stated he noticed first about two weeks after the fall,

and that it grew steadily larger for a while, but has not increased any as far as he can tell recently. Bending forward is practically normal, but slightly limited to the sides. Backward bending is limited, and is the only motion which causes pain.

The X rays (Fig. 2) showed a crushing of the body of the second lumbar vertebra. The crushing was so extreme that without any lateral displacement the body was reduced to about a third of its original thickness. Just why there was a kyphos apparently involving several vertebræ I do not know, unless the deformity of the crushed vertebra allowed the adjacent ones to slump and fall forward in such a way as to cause a backward projection of their spinous processes. Such a crush as this would almost seem to presuppose nerve injury, but he apparently never had the slightest symptoms of any. He still wears a refitted and tempered back brace, and is steadily improving.

This appearance of the kyphos several weeks after the accident is rather an unusual condition, and has been noted to occur in other reported cases. The deformity seems to be of rather a gradual onset than an immediate one unless the case is unusually severe.

CASE 4. H. J. A., male, seen February 23, 1913. This patient received his injury in September, 1912, by jumping out of a burning boathouse. He hurt his left side, and has been practically confined to the house since. He walks badly bent over, needing support from two canes. Forward bending of the spine was fair, but side bendings were much restricted. There was no exaggeration of the reflexes and no impairment of sensation. X-rays of the lumbar spine showed a fracture of the right side of the fourth lumbar vertebra, with a spicula of bone about half an inch in length separated from the body of the fourth lumbar.

This man made a practically perfect recovery in about a year's time, and is now free from any symptoms referable to his back. During this year his back was constantly supported by heavy strapping.

CASE 5. J. W. W., middle aged man. This man was riding on his wagon on November 5, 1913, when it was struck by an automobile. He was thrown out, striking on his buttocks. A large contusion appeared over the sacrum, and a hematoma formed there. He had much pain in the lower part of the back, radiating down one leg more on the left than the right. He was in bed three weeks and has been unable to walk about since on account of pain in back and legs. He never had any paralysis.

Examination on February 9, 1914, showed a very stiff and flat lumbar spine without a kyphos. All motions of the spine were restricted and painful, and muscle spasm was present. The reflexes were normal, and there was no impairment of sensation,

except that sensation was less acute on the outer side of the left thigh and calf than on the inside or on the other leg. This limitation of the normal sensation was not sharply marked.

X-rays of the spine (see Fig. 3) showed a compression fracture of the fourth and fifth lumbar vertebra, with lateral displacement of the fourth on the fifth, so that the spine as a whole above the injury was carried to the left. There is present also a fracture of the transverse process of the fourth lumbar on the left.

This man had a severe and grave injury, which gave him great pain and discomfort, and produced practically complete disability. Under baking, massage, and adequate support to his back he improved considerably, so that in about a year he was able to get about and do some work without great discomfort.

CASE 6. R. P., male, 31, laborer. Examined June 18, 1915. Accident June 24, 1913. This man was struck in the back, while stooping over, by some planks, which slipped off the roof of a house. Following the accident he was in a hospital in bed for eight weeks, during which time he stated he could not move his legs. There has been no impairment of sensation at any time, and he has had no loss of control of his bladder or rectal sphincters. He has not been able to do any work since his injury on account of pain and weakness in the lower back.

Examination of the patient showed that he stood with considerable backward sway. There was a small kyphos in the dorsolumbar region, apparently involving several vertebræ. The flexibility of his back was pretty good, there was no spasm, and practically no tenderness. His reflexes were normal and his general condition was good.

This case had been previously diagnosed as one of Pott's disease of the spine, but as the man denied any previous accidents or injuries to his spine, and stated that he had never had any previous trouble with his back, and as the X rays showed none of the usual characteristics of tuberculous bone disease of the spine, it seemed to me conclusive that his condition dated from the time of the accident, and that he had suffered a crushing fracture of the spine (see Fig. 4).

In his case the X rays showed a crushing fracture of the second and possibly the first lumbar vertebra, with a displacement of the bodies to the left and a tilting of the spine to the right. There has been considerable new growth of bone about the edges of the vertebra, especially between the first and second lumbar, more marked on the concave side than on the convex side of the curve. The kyphos shows as a result of this destructive crushing. There is no injury to the transverse processes which I can make out. The overgrowth of new bone seen between the bodies of the vertebra is rarely if ever seen in tuberculous processes, and its presence alone



severe crushes do not cause more severe and permanent injury to the nerves seems strange. One point is worthy of mention, and that is that nothing had ever been done for his back in the way of support, and that he was more comfortable sitting up than lying down. Possibly in the erect position his weight came more on the laminæ and pedicles than on the injured bodies, and he was as a result more comfortable in this position. As a matter of fact none of the cases in this series ever had any special support advised until the diagnosis was made by the X-ray, weeks or months after the original accident, and even then some of them went without any, which speaks well for their endurance and recuperative powers.

LOCATION OF FRACTURES

First lumbar	1
First and second lumbar	1
Second lumbar	1
Second and third lumbar	1
Total	4
Fourth lumbar	1
Fourth and fifth lumbar	1
Fifth lumbar	1
Total	3

This table shows that four of the seven fractures were located in the upper lumbar segment and three in the lower. In such a small series, however, this does not prove anything except that where the injury is secondary to forces applied in flexion the probabilities are that the injury will be located at the point of greatest mobility of the spine, which is at the first lumbar segment (see diagram, Fig. 6).

DIAGNOSIS

The diagnosis of this type of spinal fractures is of the greatest importance, and is not always easy. They may be produced by direct or indirect violence, and may be followed by comparatively no nerve symptoms, or by considerable paralysis, depending on the

location of the fracture and its extent. Compression of the cord by fragments of bone or by hæmorrhage in or about it, or by œdema, may occur. In the lumbar region, where the cord stops at the level of the first lumbar, injury to the cauda equinæ may occur, but is not as common as in injuries higher up.

The signs usually present are pain, localized tenderness, kyphos, asymmetry of spinous processes and possibly paraplegia, which soon clear up, rarely involvement of bladder or rectal sphincters. X-rays should be taken as soon as possible (see diagram, Fig. 7).

TREATMENT

As soon as the diagnosis is made the spine should be supported either by a plaster jacket, applied with the spine hyperextended, or the patient should be placed on a Bradford frame with pads under the region of the injury, on either side of the spinous processes, bearing on the transverse processes. Fixation should be continued for at least six months. Operation is rarely indicated unless there is a definite cord injury. Then it should be done without too great delay.

PROGNOSIS

The bony repair is generally good in these lumbar cases, and although there may be a persistent stiffness, the supporting function of the spine is generally good, even in spite of a kyphos, which may tend to increase somewhat. Permanent disability, so far as doing heavy laborious work goes, generally follows such an injury, and as a rule a light back brace is needed for some time or always to give comfort and stability. The prognosis as far as life is concerned is generally excellent provided no cord injury has occurred.

NOTE.—Since this paper was written the author has had four more cases all involving the lumbar vertebræ. One case only has had cord symptoms, which followed the crushing of three vertebræ, *i. e.*, the twelfth dorsal and the first and second lumbar. She is making a slow and gradual recovery. The others were unaware of their condition until X rays were taken. The only symptoms were those of a lame, sore and weak back.

DOUBLE URETHRA WITH OPERATION

REVIEW OF THE LITERATURE¹

By DAVID W. MACKENZIE, M.D., NEW YORK

THIS case is reported from the Second Genito-Urinary Service of the Bellevue Hospital. I here wish to thank Dr. Keyes, the Chief of the Division, for the case.

The patient, a young man 26 years of age, single, born in the United States, a photographer by occupation, was admitted to our service at Bellevue Hospital on November 17, 1912.

Chief complaint Sinuses of penis from which urine escapes.

Family history Unimportant.

Past history As a child he was troubled with enuresis nocturna, continued until 12 years of age, occasionally since. As far back as he can remember he passed urine from two openings, one in the normal position on glans penis, and one in the frænum. In 1899 after ten days of frequent and painful urination, he had a suprapubic operation in the Buffalo General Hospital for a stone in the bladder. Thinks no stone was found. Was not cystoscoped. The frequent and painful urination continued for a long time after this operation. About three years later, 1902 or 1903 he noticed a small lump about the center of the ventral surface of the penis. It was not painful. Thinks it increased slightly in size. In April, 1912, under local anesthesia it was cut down upon and a stone about $\frac{3}{4}$ inch in diameter removed from the urethra. The sinus has continued since.

In November, 1912, he went to the New York hospital to have these extra openings in the penis closed. Perineal section was performed, tube inserted and left in position for one week. This opening has also refused to close. Following this operation his frequency was much diminished. Patient states that during erection the distal end of the penis to about one inch behind the glans remains flaccid.

Physical examination on admission General appearance, a well developed healthy young man about 5 feet and 10 inches in height, weighing 150 pounds. He has a scar of suprapubic wound on abdomen. Urinary meatus normal in size and position. Sinuses three in number, one at the frænum, one about $1\frac{1}{2}$ inches from the frænum on ventral surface of the penis, and one in the perineum. Rectal examination showed no abnormalities.

X ray examination of urinary tract was negative for stone.

Cystoscopic examination revealed a normal bladder with small sacculi into which right ureter opens.

Phenolsulphonephthalein output was normal. Exploration with probes and sounds revealed the

existence of a urethra apparently normal except for a slight stricture in the bulb admitting a 26 F sound. Of the three fistule the posterior (perineal) one opened into the membranous urethra just behind this stricture. The other two (at frænum and near scrotum) opened into a common passage which readily took a 26 F sound and entered the urethra in the bulb (in front of the stricture).

Perineal sinus was excised, and its opening at the junction of membranous and prostatic urethra closed. The subjacent canal was split from frænum to bulb. It was found to be lined with normal mucous membrane, and surrounded, with its companion urethra, by a common corpus spongiosum. It was extirpated completely from the bulb forward. This was somewhat difficult on account of its close relation with the upper passage. The wound healed by primary intention, and the patient left the hospital passing all his urine through the normal passage.

In the following brief review of some of the different types of such canals, I will first give the atypical ones, the existence of which has been used as an argument against the double urethra theory, and close with the two main classes of long anterior canals, those that end in a cul de-sac, and those that enter the normal urethra.

In Luschka's (1) case, a young man who had committed suicide at the age of 19, the penis was found to be normal, but at the boundary of the pubic hair, on the dorsal aspect of the organ an opening 4 mm in width was seen, leading into a canal of 1.5 cm.² At the origin of this canal four openings were discovered, being the excretory orifices of a gland which was actually the median anterior lobe of the prostate displayed on the penis.

In Cruveilhier's (2) case there was in addition to the normal urethra, a narrow canal which originated at the corona glandis and was distinguished by its considerable size corresponding almost to the entire length of the penis, and extending exactly in the middle line from the root of the penis to the

¹Luschka reports the duct as 155 cm long but it is misquoted by Leberon (J. d. Urol. 1912 n. 403) as 15 mm long.

²Paper read at Seventh Pan American Congress of Medicine, San Francisco June 29, 1915.

dorsal aspect of the glans, where it opened above the external urethral orifice in a much narrower round opening. This case came to autopsy where it was shown that the long fistulous tract was derived from the confluence of the two ejaculatory ducts, which, instead of traversing the prostate in the usual manner, passed around to the dorsum of the penis which thus became the bearer of a separate urinary and seminal duct.

Monod (3) reports a case with a very superficial abnormal canal subjacent to the true urethra, parallel with the raphe of the penis and the scrotum. It passed across the perineum and terminated in the rectum, which had no anal opening.

Tribram's (4) patient, 64 years of age, was admitted to the hospital for retention of urine. At a distance of 3.6 cm behind the corona an opening 9 mm in diameter was seen in the form of a funnel which was continued into a canal 3.9 cm in length, situated at the level of the junction of the corpora cavernosa and terminating in a cul de sac. There was no communication between the urethra and the abnormal canal.

Examination of the supernumerary urethra showed that its lining was pale and resembled mucous membrane. This patient later came to autopsy and then it was found that the abnormal canal extended as far as behind the pubic symphysis. About 2 cm from the vesical orifice of the urethra the anterior vesical wall presented a funnel-shaped retraction which led into a narrow canal 2 cm in length and lined with vesical mucosa, but did not join the other.

Lebrun (5) reports an observation of Marion on a more exaggerated case than the above. This young man, 20 years of age, was admitted to the hospital because of the escape of urine from an abnormal orifice at the root of the penis below the pubic symphysis. This orifice was situated at the pubic end of a long gutter-like furrow extending from the root of the penis to the normal meatus at the tip of the glans. It gave access to a canal which admitted a No. 14 catheter into the bladder. Though the normal urethra only a No. 16 bougie could be passed into the bladder and a stricture was met

10 cm from the meatus. In the operation the vesical termination of the accessory urethra was exposed and resected. Good repair with complete cure of incontinence.

Histological examination of specimen showed that it resembled in every way the structure of the normal urethra.

Stockmann (6), Rona (7), Himmel (8), Broca (9), and Frumstein (10), also report cases with accessory canals extending in the same general direction to the bladder without connection with the normal urethra.

Lissowskaja (11) reports a case where the abnormal passage extended from the dorsum of the penis across the upper margin of the symphysis to the anterior wall of the bladder. It was extirpated and microscopically presented all the layers of the normal urethra.

Of those ending in a cul de sac Jeanlraux's (12) patient is a fair example. He had an accessory urethra 6 cm in length opening into the balanopreputial groove and terminating near the penoscrotal angle. The supernumerary urethra was extirpated. Histological examination of the specimen showed it to be a real urethra with stratified cylindrical epithelium and a corpus spongiosum.

Perkowsky's (13) case presented a second meatus just behind and above the normal meatus. It admitted a No. 16 catheter for 17 cm terminating in a cul de sac beneath the symphysis. The lining was the same as the normal urethra.

Similar cases ending blindly have been reported by Nardini de Calvi (14), Vernicil (15), Picardet (16), Luxardo (17), Lejars (18), Englisch (19), Lillbogen Neumann (20), von Dittel (21), Frigerio (22), Englisch (23), Posner-Schwytzer (24), Nohl (25), Martin (26), Le Fort (27), Delbet (28), Stimson (29), DeKeersmaecker (30), Dupot (31), Miccoli (32), Heller (33), Arning (34), Hensel (35), Herman (36), Fantl (37), Worms (38), Walker (39), Terulano (40), Porocz (41), and Lanchan (42).

Of those communicating with the true urethra Marion's (43) patient, 20 years of age, had a congenital totipot of the glans. A few drops of urine occasionally escaped from it. The normal meatus admitted the exploratory bougie to the bladder. A bifurcated bougie was

admitted into the supernumerary meatus and easily passed beside the normal urethra into the bulbar region. Injection of methylene blue into this canal returned through the principal urethra. The accessory canal was extirpated. The structure was that of a normal urethra.

Meisels' (44) patient was a boy of 12 years of age with enuresis nocturna and diurna. The tip of the glans presented a normal urethral orifice but the urine escaped in a fine stream from a small orifice below the external urethral opening, only a few drops of urine came from the orifice at the tip of the glans. Endoscopically it could be shown that there was an orifice more than 8 cm. from the urethral meatus at the upper aspect of the lower urethra, the fluid injected into the upper canal passed through this orifice into the lower canal. Meisels considers this a case of second lower urethra but it has also been claimed that the lower passage was the true urethra while the upper passage represented the accessory one. This case resembles very closely the one reported in this paper.

Woods (45) Poisson (46) Dollinger (47) and Djeduran (48) report similar cases where the long accessory canal connects with the normal urethra and through both of which urine passed.

Stinelli (49) reports the histological findings in a case of double penile urethra in a boy of 10 years. The posterior urethra was not available.

A brief discussion of some of the theories follows.

The male urethra originates from two genetically distinct portions of the embryo, the prostatic and membranous portions resulting from the urogenital sinus while the remaining portion originates at a later period from the folds of the genital ridge or tubercle. The entire female urethra develops from the urogenital sinus. Doubling of the male urethra is rare, in fact some investigators deny the existence of a true double urethra but the cited cases are sufficiently numerous and authentic to have occasioned numerous theories to explain their nature and origin. There are two important points to be settled according to Lebrun (51). First is the ab-

normal canal a urethra or merely some diverticular or canalicular excretory formation? Second, granted it is a true urethra, how is its formation to be explained?

1. Is the abnormal canal a urethra? Luschka (1) explains these canals as misplaced excretory ducts of aberrant prostatic lobules. This he found to be true in his own case. It certainly does not apply to all those cases in which there exists a communication of the abnormal duct with the urethra or bladder. Moreover, the autopsy findings in Pribram's (3) case positively show that the explanation does not unconditionally hold good for all cases in which the abnormal passage terminates in a cul de sac.

Tarulli (50) suggests that the canal might either be a prolongation of the posterior glands at the dorsal aspect of the urethra, or the urethra having become bifurcated through some mechanical factor the supernumerary canal would simply represent the upper bifurcation of the urethra ending in a cul de sac.

Cuvillier (2) found in his case which came to autopsy that the canal was derived from the confluence of two ejaculatory ducts which instead of entering the prostate in the usual manner passed around it to the dorsum of the penis. This is the only case of its kind I find in the literature.

Vernieu (15) attached great importance to the excretion of fluid through the abnormal passage and accepted the theory of prostatic canals.

Lejars (18) admits this view for some cases, but thinks that it does not explain the diameter of certain canals in view of the slight importance of their excretory function. Moreover the ectopic prostatic lobule was found only in Luschka's (1) case in support of his theory. The stringy viscid fluid which sometimes comes from the abnormal canal is not necessarily prostatic fluid. It may be from glands analogous to the urethral glands.

Posner and Schwartz (24) believe that the origin of the abnormal canal is a fecund duct. This may apply to short canals but it does not appear probable for canals which occupy the entire length of the penis.

Moreover the findings on histological ex-

amination of these canals indicate that all the examined cases were true urethras

2 The explanation as to the formation of these accessory urethras varies likewise according to the different authors. The following are some of the more probable:

Le Fort (27) explains the formation of double urethra as due to an anomaly in the development of the urethral strand. This opinion is shared by Delbet (28) who assumes that the epithelial strand destined to become the urethra proliferates too far upward, and becomes longitudinally divided in its middle so that there are two portions of the epithelial strand, one above the other, which promptly becomes separated by the interposition of mesodermic tissue. These two completely separated strands are supposed to give rise to the two urethras, the upper one of which may undergo partial atrophy terminating in a cul de sac. Lebrun (51) is inclined to accept the theory of Le Fort (27) and Delbet (28), and he attributes the formation of double urethras to an anomaly in position and dimension of the primitive epithelial strand destined to become the urethra

When this epithelial strand is especially well developed and slightly deviated toward the dorsal aspect of the penis as in epispadias, it will become longitudinally divided by the fusion of the two genital folds at the level of their upper margins. In consequences of this fusion the urethral strand is divided into a principal lower portion which gives rise to the normal urethra and an upper portion which forms the supernumerary urethra.

Kaufmann (52) assumes the occurrence of fistulous perforation of the genital ridge in consequence of urinary retention in the posterior urethra, at the time when the anterior urethra is not yet developed. When the anterior urethra begins to functionate, a septum is found between the fistula and the urethra, this seems incorrect because the fistula would not have the same structure of its walls as the urethra

Meisels (44) interprets the origin of the two parallel urethras in such a way that the two separate beginnings of the urethra diverge in the direction of their growth

Low (53) suggests that the urethra originates through the destruction of part of the stratified epithelium which fills the mesodermal genital groove. It is possible for two ducts instead of one to originate within this solid epithelial plug

Rona (7) regards all accessory ducts of the penis as developmental anomalies which originate through constricted longitudinal folds of the urethra

Klebs (54) considers the second urethra as an arrest of development of the vesicopenile cleft, a healed epispadias. But although the epispadias accounts for the opening of the urethra on the dorsum of the penis it does not explain the formation of two canals

By Lejars (18) this anomaly is classified under the heading of epispadias. In his opinion the cavernous buds are originally double, epispadias being a failure of these buds to unite. Furthermore, in the apposition of the two cavernous buds, a non-united strand is left in the middle constituting the doubled urethra. This theory is very simple and would be highly satisfactory if the penile bud was originally double, but according to the investigations of Rathké and Tourneux (56) it is simple, which discredits the above theory.

Meyer (55) raises an objection to Lejars' theory and claims that the corpora cavernosa are not concerned in the transformation of the urethral groove into the urethral tube, the urethra being surrounded only by its own corpus spongiosum. Furthermore, the genital ridge is single from the start so that there can be no junction or adhesion. Meyer explains the genesis of double urethra as follows: The upper wall of the urethra originates from the ventral wall of the cloaca. If the latter is placed abnormally far in the ventral direction, it enters into relation with the ectoderm in a certain area. This is followed by total or partial mesenchymal constriction and separation of the abnormally dorsally situated epithelia. Being provided with the formative material for the urethra, these epithelia then grow out with the penis into long channels. According as the constriction is total or partial they terminate blindly, or they communicate with the blad-

der and with the skin on the dorsal aspect of the penis, or at the glans. The lower wall of the urethra becomes constricted off relatively late from the external skin at a time when the mesenchymal tissue is further differentiated, passing behind forward, so that the urethral segments of the glans is detached from the skin, and closed a few weeks later than the posterior segments of the penile urethra. Hence there can be no canal in the lower wall which is composed of the primarily canalized posterior urethral segments derived from the urogenital sinus as well as of the urethral portion in the penis which is constricted off at a much later date.

The following plausible explanation is offered by Meyer (53) for the formation of accessory canals at the lower side of the penis. The epithelial ridge from which the urethra is formed is surrounded by connective tissue in such a way that the lower branch of the ridge (which is cruciform in cross section), becoming constricted off by the approximating lips of the connective tissue, is crowded against the surface of the lower side and detached. When this constriction fails to occur, the lower branch nevertheless is not utilized for the formation of the urethra but it is secondarily constricted off and forms a submucous canal. In case the primary constriction takes place but not the detachment the constricted epithelial strand becomes promptly surrounded by ectodermal tissue and a subcutaneous canal is formed.

CONCLUSIONS

The occurrence of more or less complete duplication of the male urethra, involving the canal from the bulb to the meatus, can not be doubted, as a large number of well authenticated instances of several degrees of the anomaly have been recorded. Accessory canals have been described of about equal size to the normal urethra and freely communicating with it in the bulb as in Mercet's and the author's case.

In other observations one passage was smaller than its fellow with which it connected or ended in a cul de sac. Perfectly authentic cases of accessory urethras extending to the bladder have also been reported.

The development of the anterior and posterior male urethra from distinct embryonic structures renders a complete congenital duplication of these parts extremely rare. The pathogenesis of all urethral duplications meets with difficulties and many explanations have been suggested, the most probable theory referring the formation of a double urethra to anomalies of the epithelial urethral strand in the embryo.

BIBLIOGRAPHY

1. LESCHKA. Virchow's Archiv, 1865, xxxii, 592.
2. CROQUISSE. Traite d'anatomie descriptive, 1852, p. 614.
3. MOVON (quoted by Desnos et Minet). Traite des maladies des voies urinaires, 1909, p. 278.
4. PRAGER. Preger Vierteljahrsschrift, 1867, iv, 44.
5. LEROUX. Uretres doubles epispades, J. d'urolog., 1913, iv, 35.
6. STOKMANN. Monatsbericht d. Krankheiten des Sexualapparates 1897, p. 474.
7. ROVA. Ueber Doppelbildung des Harns. Deutsche med. Wochenschr., 1905, No. 21, p. 831.
8. HICQUEL. Zentralbl. f. Chir., 1895, p. 397.
9. BACCA. Epispadias avec uretra normal. Bull. et mem. Soc. de chir., de Par., 1912, xl, 1502.
10. FRONSTEN, M. Un cas d'uretre double. Rousky, Arch., 1913, xii, 785; J. d'urolog., 1913, ii, 714.
11. LISSON-KAJA. Ein Fall von accessoirer Harns. Zentralbl. f. d. ges. Chir., 1914, v, 331.
12. JEANTON. Uretre accessoire infecte. Communication. French Urol. Ass., 1911, Oct., Presse med., 1911, p. 943.
13. PRZKOWSKI. Zentralblatt f. Chir., 1883, p. 316. (Medycyna, No. 14, 1883.)
14. MARCHAL (de Calvi). Bull. Acad. Nation. de med., 1851, xvi, 649.
15. VERNETZ. Bull. Acad. de med. 1852, p. 670, also Arch. gen. de med., 1866, i, 660.
16. PICARDY. These de doct., Paris, 1853.
17. LUCAREDO, GIRON. Interne de Sc. Med., 1882.
18. LEJARS. Ann. d. mal. des. org. gen. urin., 1888, p. 397.
19. ENGLISH. Wiener med. Presse, July, 1888, Nos. 27 and 28, p. 935.
20. FLEHGEN NEUMANN. Wien med. Presse, 1888, Nos. 51 and 52.
21. DITTEL. Wien med. Wochenschr., 1889, p. 395. (Vienna Medical Society, March 8, 1889.)
22. FAIGERO. Rendic. d. Roy. Inst., Lombard., 1891, xiv, 467.
23. ENGLISH. Internat. Zentralbl. f. Physiol. u. Path. d. Harn., 1892, vi, Zentralbl. f. d. Krankh. d. Harn. u. Sexualorg., 1892, No. 1.
24. FOSNER AND SCHWABER. Berl. Klin. Wochenschr., 1893, No. 35, p. 843.
25. NORT. Arch. f. Dermatol. u. Syph., 1895, xxxi, 434.
26. MARTIN. Arch. de med. et pharm. mil., 1895, p. 64.
27. LEFORT. Anomalies fistuleuses congenitales du penis. Ann. d. mal. d. org. gen. urin., 1896, xiv, 648.
28. DELBET. Ann. d. mal. d. org. gen. urin., 1898, p. 303.
29. SIMMON. J. C. Pacific M. J., 1898, vi, 571.

- 30 DE KEERMAECKER. *Ann et bull Soc med, d'Anvers*, 1898
31. DUPOT. *Ann d mal d org gen urin*, 1902, p 77
- 32 AIEVOLI. Urethra duplex condotti par urethra Gazz degli osp della clin, 1905, No 112, Arch gén de med, 1905, II, 2177
- 33 HELLER. *Ztschr, f Urol*, 1908, p 612
- 34 ARNING. *Arch f Dermat u Syph*, 1909, xciii, 232
- 35 HEYSEL R. *Alkzessonsche Gange des penis*, *Arch f Dermatol u Syph*, 1910, c, 313
- 36 HERMAN, L. *Para Urethrae*. *N Y M J*, 1913, May 3, p 922
- 37 FANTL. *Über Doppelbildungen der Harnrohren*. *Folia Urol*, 1913, viii, 193
- 38 WORMS, G. *Sur un cas d'uretre double hypospade*, *J d'urol*, 1913, iv, 775
- 39 WALKER, J R THOMSON. *Surgical Diseases and Injuries of the Genito-Urinary Organs*. London 1914, p 571
- 40 FERNANDO. *Contributo clinico operatorio dell'uretra duplex*. *Gior internaz d sc med*, 1914, xxxv, 366
- 41 POVOZZ, M. *Blind ending 12 cm lange zweite Urethra*. *Ztschr f Urol*, 1914, viii, 569
- 42 LENEHAN, WALTER. *Case of congenital double urethra*. *Am J Urol*, 1912, p 598
- 43 MARIOV. *Un cas d'uretre double chez l'homme*. *J d'urol*, 1912, i, 235
- 44 MEISELS. *Wien med Wchnschr*, 1893, Nos 31 and 33 *Pest med chir Presse*, Budapest, 1893, xxx, 585
- 45 WOODS, H. *Brit M J*, 1912, Sept, p 644
- 46 POISSON. *Ann d mal d org gen-urin*, 1886
- 47 DOLLINGER. *Orvosi hetil Budapest*, 1890, No 5 (quoted by *Englisch Zentralbl f d Krankh d hain u Sex Org*, 1895, vii, 65)
48. DJEDURIN. *J russ d mal cut*, 1905, x, Arch d Dermatol u Syph, 1905, lxxx, 276
- 49 STINELLI, F. *Reperto di uretra Maschile*, *Anatomischer Anzeiger*, 1910, p 513
- 50 TARUFFI. *Boll d sc med*, Bologna, 1912, II, 381.
- 51 LEBRUN. *Les uretres doubles*, *J d'urol*, 1912, II, 381
- 52 KAUFMANN. *Deutsche Chirurgie*, 1886
- 53 LOW. *Wien med Wchnschr*, 1900, p 1380
- 54 KLEBS. *Handb d pathol Anat*, 1876, I, 1136
- 55 MEYER, LUBERSCH. *Ostertag's Ergebn d allg Path*, 1911, I, 505
- 56 TOURNEUX. *J Anat et d Physiol*, 1884 to 1886

DEPARTMENT OF TECHNIQUE

REPORT OF A CASE OF EXSTROPHY OF THE BLADDER OPERATED ON NEARLY THIRTY YEARS AGO¹

WITH SUBSEQUENT HISTORY

By RANDOLPH WINSLOW, M.D., F.A.C.S. BALTIMORE.

IN May 1886 Georgie T., a white female child aged six years, was brought to the Hospital of the Good Samaritan, Baltimore, by Doctor Samuel T. Earle, who placed her under my care.

She was a small but well nourished and very intelligent child, who was in a deplorable condition. In addition to a large congenital prolapse of the rectum she was suffering from exstrophy of the bladder, the opening being $\frac{3}{4}$ by 1 inches in diameter and trefoil in shape. The exposed mucous membrane was red, vascular, and bleeding, covered with mucus, ammoniacal and offensive in odor. There was constant dribbling of urine and her skin and clothing were always wet. The pelvic bones were widely separated and her gait was awkward and waddling. No hernia was present in either groin. There was no urethra but only a shallow groove where the urethra should have been. The labia were separated from each other and the clitoris was not seen. The vagina was apparently present, but nothing was determined in regard to the uterus and ovaries. The umbilicus was absent. Her appetite was good. Dr. Earle operated on the prolapsed rectum with the thermocautery and sub-

sequently he narrowed the anal orifice, eventually curing her of this malady.

On June 1, 1886, I performed a modified Wood's plastic operation for the relief of the exstrophy. An umbilical flap was turned down with its raw surface outward and two small flaps were turned up from the vulva and sutured to the lower edge of the umbilical flap, leaving a small opening at the lower margin for the escape of urine. Two lateral abdominal flaps of considerable size were raised and twisted with their raw surfaces inward so as to cover the other flaps, and their margins were sutured to the middle line. Catgut sutures were used for holding the raw surfaces together and sublimated silk for the external wounds. A large portion of the extensive raw surface of the abdomen was closed with sutures, leaving only a narrow uncovered strip to be healed by granulation. The umbilical flap consisted of very thin skin and but little subcutaneous tissue, while the lateral flaps were pretty thick and vascular. The surfaces were dusted with iodoform and covered with gauze and absorbent cotton. The patient was considerably shocked but rallied easily and she suffered little or no pain subsequently. The urine escaped freely from the small opening between the

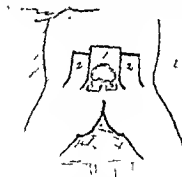


Fig. 1

Fig. 1. Exstrophy of the bladder. Flaps outlined: 1, Umbilical flap; 2, lateral flaps; 3, labial flaps.

Fig. 2. Umbilical flap reversed and united to reversed labial flaps. 3. The shaded portion indicates the raw surfaces of these flaps.



Fig. 2



Fig. 3

Fig. 3. 2, 2. Lateral flaps placed over the other flaps and united in the middle line. All the portions sutured. Shaded portion indicates the extent of denuded surface which could not be sutured and which healed by granulation in a few weeks.

¹ Read before the Southern Surgical and Gynecological Association, Cincinnati, December 13-15, 1915.



Fig 4 Result after healing

flaps. For several days her temperature remained nearly normal but on the third day febrile symptoms began to set in and an examination showed the wound to be in good condition, but an erysipelas ambulus was discovered traveling upward from the buttocks toward the flaps. On the fifth day the erysipelas reached the flaps but was fortunately very superficial in character and did not cause much disaster. A strip of the left flap about one-half to three-quarters of an inch in width along its middle and lower edges sloughed and left a gap to be healed by granulation. This gap was materially lessened by the use of deep silver wire sutures shot on lead plates. Healing of all wound surfaces was accomplished in about six weeks.

The condition of the child was vastly improved but there was, of course, no continence of urine. It was possible, however, to keep her drier more comfortable, and less offensive to her neighbors. This was about as good a result as was attainable at that time, indeed any other operation would have been well nigh impossible on account of the marked prolapse of the rectum that was present. At the present day I think some other procedure should be employed in cases of exstrophy of the bladder, and I personally favor the implantation of the ureters with the trigone of the bladder into the sigmoid or rectum, the extirpation of the remainder of the bladder and the closure of the gap in the abdominal wall with sutures.

I have not thought this case worthy of publication on account of the method of procedure employed or by reason of the success of the operation, but because of her subsequent history, of which I have only recently become cognizant. After remaining six months in the Samaritan Hospital, she was removed to Bay View Asylum, where

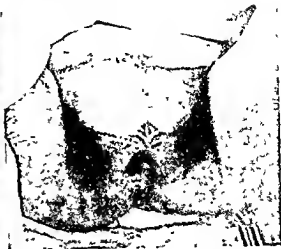


Fig 5 Condition of parts in December, 1913

I subsequently saw her upon several occasions; the last time probably in 1890, when she was ten years of age.

In Howard A. Kelly's *Operative Gynecology*.* I find the following account evidently referring to the same girl:

In a case of a girl of 15 (G. T., No. 3,869, October 14, 1895) the pubic bones were separated four centimeters with a thin, sharp-edged fibrous band between them, above this there had been a total defect of the anterior bladder wall, covered by inverted flaps of skin taken from the sides and so adapted as to leave only a small orifice open just above the fibrous band, through which the urine escaped. By rectal examination, I found an infantile uterus and ovaries, and on making a cystoscopic examination between the flaps two little oval openings representing a double hymen were discovered on the posterior wall of the bladder, a sound passed through them led up to the cervix uteri.

I lost sight of the girl and did not know what had become of her until January, 1914, when I received a letter from Dr. Charles B. Reynolds of Philadelphia in regard to her. She had been married some years and had been delivered of a child by Dr. Reynolds a short time previous to the date of his letter to me. This was her third child, the first having been born in November, 1901, following an instrumental delivery. This child was born alive. The second child was delivered by podalic version in 1903 and was born dead. The mother was badly lacerated and had her injuries repaired at the Cambridge Maryland Hospital.

During the third labor in December, 1913, Dr. Reynolds saw her in consultation and finding her condition serious had her removed to the

Medico Chirurgical Hospital, where she was etherized and delivered of a large dead baby that presented by the breech. While she was in the hospital, a skiagraph was taken of her pelvis which showed an absence of the symphysis pubis and a gap of 3 inches between the pubic bones. In commenting on her condition, Dr. Reynolds says, "She appears to be a strong and an otherwise well developed woman and quite intelligent." She was sensitive about her malformation and disinclined to allow any examination of her genitalia. In January, 1915, she was delivered by Dr. Reynolds of a fourth child, a girl weighing 9 pounds, which was born alive. This was a shoulder presentation which was delivered by podalic version.

Ectrophy occurs much less frequently in females than in males, but the condition is none the less deplorable. In many cases both the external and internal organs of generation are malformed or undeveloped and the woman, if she lives to adult life, is usually incapable of bearing children.

The first fact, therefore, that makes this case

noteworthy is that she has come to term four times within a few years. Secondly, the labors were all dystocic; one child having been delivered with forceps and the others either by podalic version or by breech extraction.

When we consider the absence of the symphysis pubis and the wide separation of the pelvic girdle, the diastasis of the recti muscles and the weak condition of the lower abdominal wall, it is not remarkable that she was unable to give birth to a child in the normal manner and that the deliveries were all abnormal.

I find it stated by Da Costa that only 30 per cent of the victims of this malformation live beyond the twentieth year, it is, therefore, very gratifying to me to know that this woman, upon whom I operated 20½ years ago, is still alive and in reasonably good health.

In a letter received from Dr. Reynolds on December 10, 1915, he says: "The woman is well nourished, intelligent, and is enjoying good health, though she has prolapsus uteri. She is able to perform her regular household duties satisfactorily."

IMPLANTATION OF THE TRIGONUM INTO THE SEGREGATED LOWER END OF THE ILEUM¹

By VILRAY P. BLAIR, A.M., M.D. F.A.C.S. St. Louis

THIS single case is reported partly because the operation proved a failure, in that the patient died, and partly because it was designed with the hope of overcoming two of the obstacles that have been encountered in the attempt to successfully form a visceral receptacle for the urine in ectrophy of the bladder. The difficulties lie in preserving the blood supply to the trigonum and in protecting the kidneys. In regard to the former it succeeded but presumably failed in the latter.

The patient was a girl six years old. At examination, the labia majora were found well formed posteriorly and separated widely anteriorly. There were two small "dog ears" on the anterior median part of the labia majora which somewhat resembled and were taken for the labia minora. Between the posterior parts of the labia majora was a transverse slit three millimeters wide with a somewhat fluted mucous lining. This was taken for the external opening of the vagina. The umbilicus was low. Below the umbilicus the recti muscles seemed to separate leaving a hernial protrusion which extended from the umbilicus to the pubis and when the child cried, stood up about five centimeters. Most of this protrusion was

covered with skin but its extreme lower part was red and apparently covered by mucous membrane, this patch was about two centimeters across. In this there were two small vertical slit openings, one millimeter long, from which urine came in jets alternately. The left slit was at a higher level than the right. The diagnosis was ectrophy of the urinary bladder, complete absence of all bladder wall except the trigonum, deformity of the external genitals and absence of the lower end of the vagina.

The operation was done in two steps. The first consisted in dividing the ileum ten inches from the cecum, the cut end of the distal segment being closed by suture, the proximal part being implanted into the ascending colon. The idea was to use the ten inch segment of the ileum for the urinary receptacle in the hope that the ileocecal valve would protect the ureters from ascending infection. At the second operation this segment was found to be free from feces. There was some discussion at the time as to the propriety of turning the urine into the right half, the absorbing part of the colon, but there seemed to be no end result from this.

The second stage of the operation was done three months later when the trigone was freed from the abdominal wall and left attached to a triangular flap of peritoneum attached below and containing a ureter at each border. The blood supply was so free that many ligatures had to be applied after the trigone was freely

¹ Read before The Southern Surgical and Gynecological Association, Cincinnati, December 23-25, 1915.

mobilized. No difficulty was encountered in making a lateral implantation into the lower segment of the ileum. It was also possible to cover the site of implantation and the raw surface of the peritoneal flap, carrying the ureters, with parietal peritoneum even down to the triangular ligament which was developed into a thick ligamentous band that replaced the symphysis pubis. There was no subsequent urinary leakage.

A third operation, viz., the strengthening of the wall at the site of the hernia by the transplantation of fascia lata had been contemplated for a later date.

The child apparently did well for a year, holding its urine all night and during the day passing it about every two hours with plenty of warning. They lived at a distance and only one specimen of urine was obtained, which was

six months after the implantation. Examination showed a specific gravity of 1.016, alkaline, some albumin, no sugar and no casts. The child at this time was in excellent health. About one year after the second operation the child became sick, lost weight and had a waxy color. When seen two months later she looked bad and complained of a great deal of cramping pain in the lower abdomen which suggested that a urinary calculi might have formed in the new urinary bladder. An X-ray picture could not be made without an anæsthetic and a request to come to the hospital was deferred. The blood at this time showed a slight leukocytosis and 77 per cent polymorphonuclear cells. About one month later the child died, no autopsy was performed but the attending physician reported the death due to uræmia.

A SIMPLE MODIFICATION OF AN OLD VAGINAL SPECULUM

By HERBERT W. HEWITT, M.D., F.A.C.S., DETROIT

THE right hand figure in Figs. 1 and 2 shows a vaginal speculum, weight, and chain, which has for years been sold under the name of Metcalf vaginal speculum. I have used this speculum in my work for ten or more years. Its main disadvantage is that the chain and weight are easily disconnected from the speculum. This may be prevented by substituting a simple harness snap for the long chain and closing the

shepherd's crook wire stem of the weight, as shown in the left-hand figure in Figs. 1 and 2.

Another improvement has been made by the instrument maker as shown in Fig. 3, in the right hand figure. The new one is made much lighter and has a trough for blood and irrigating fluids. This simple modification can be made in a very few minutes and makes the most satisfactory vaginal speculum I have ever used.

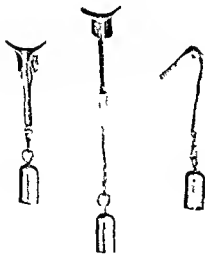


Fig. 1

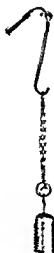


Fig. 2

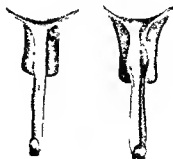


Fig. 3

NITROUS-OXIDE-OXYGEN ANALGESIA IN LABOR¹

By W. C. DANFORTH, B.S., M.D., F.A.C.S., EVANSTON, ILLINOIS

Attending Gynecologist, Evanston Hospital
From the Obstetrical Building of the Evanston Hospital

IMMEDIATELY after the appearance of the papers of Drs. Webster and Lynch in March, 1915, describing their experience with nitrous oxide analgesia in obstetrics, the use of this method was begun in the obstetrical department of the Evanston Hospital. Previous to that time nitrous oxide had been used in the hospital for minor operations, painful examinations, and for a considerable number of major surgical procedures, including cesarean section. All general anesthetics had been begun by the administration of nitrous oxide for a period of several years. Since beginning its use in labor, it has been used in 33 cases. Of these, 31 have received it for periods of two hours or more. The longest time it has been given to any patient has been seven hours. Of these 31 cases, 7 have taken it for three hours, 1 for five hours, 1 for six hours, and 1 for seven hours. The remainder of the 33 cases have received it for periods varying from two to three hours.

Careful records have been kept of the cases in which gas has been used, a special blank being prepared for the purpose upon which has been noted the character of the case, the length of time the gas was given, the effect upon the fetal heart, the effect upon the maternal heart, the effect upon the pain, the character of the analgesia, and the condition of the lobe at birth. We are, therefore, in a position to know precisely what our results have been and to compare them with the results obtained by other means of relieving pain.

We have so far been satisfied with results which have been obtained. We do not find that gas lessens the force of the uterine contractions, provided that it be given only to the degree of analgesia. On the contrary in some cases, the uterine contractions seem to be better after the gas has begun than they were before. After the patient has learned how to breathe the gas and obtains relief from pain, she will work much more satisfactorily than she did before. As she is at no time unconscious, she is amenable to suggestion and will, as a rule, follow directions accurately. Patients are much more easily managed under a properly given gas analgesia than when the mentality is clouded by the effect of ether or chloroform. The gas can be given over a much

longer time than ether, and as our experience has grown, we have been inclined to begin the administration of the gas earlier than we did at first. We have observed no harmful effect upon the fetal heart. Administration for hours in long labors has been accompanied by no change in the heart tones which we have been able to ascribe to the effect of the nitrous oxide. The maternal pulse has in no case undergone any change that seemed disagreeable to the gas. We have had no asphyxiated babies. The condition of the child at birth has in every case been good. In several cases the child has been observed to cry before birth was complete in at least two cases as the shoulders came over the perineum. The placental stage has seemed to be shortened, probably because the contractility of the uterus has not been diminished by the anesthetic.

In no case has hemorrhage occurred. In one case in which the gas was continued for several hours the uterus was puffed. This woman has a uterine fibroid of considerable size and had had a long and tedious labor, terminated instrumentally, and was not bleeding dangerously at the time, the uterus being packed for prophylaxis.

The technique has been in all essentials that described in the papers of Lynch and Heaney. It has been developed as a result of our own experience which has led us to about the same point so far as the mode of administration is concerned as it has them. We had the advantage of his description of the technique given by Lynch in his paper.

Administration of gas is begun at the end of the first stage or earlier if the pains are severe enough to cause real suffering. There seems to be no objection to beginning it at any time during the latter half of the second stage if the attendant desires. A small dental nose piece is used. The hand upon the fundus of the uterus detects the beginning contraction at which time the inhaler is placed over the nose and the gas turned on. The patient is told to take deep quick breaths, opening the mouth as soon as the pain of the contraction is greatly lessened or disappears. We have a few times tried the suggestion of Lynch, namely that the patient be given a light to watch and instructed to open the mouth if the light seems to waver. Usually this is not

necessary, as a patient of intelligence soon learns to open the mouth and so keep herself from passing from the stage of analgesia into that of anesthesia. From four to eight breaths of gas are necessary to produce analgesia; the amount necessary varying with the individual patient.

We have experimented with various modes of administering gas. For a number of cases we have given nitrous oxide alone for the first two or three breaths, and then added from five to ten per cent of oxygen. In a considerably larger number we have used the gas alone, only adding oxygen if a trace of cyanosis appeared. The cases in which nitrous oxide alone has been used, with the addition of oxygen only for cyanosis, or perhaps at the end of the pain for the purpose of rapidly freshening up the patient, have seemed to us to be the most satisfactory. After the stage of analgesia is reached, which is usually attained during the first half of the pain, the remainder of the pain will be borne without the administration of gas and without the feeling of pain. In some cases we have had to continue the administration of gas throughout the greater part or all of the pain. This process is repeated with each pain over as long a time as may be necessary. As the head passes over the perineum, we have usually changed the small nose piece for a larger mask which covers the mouth and nose in order that a deeper degree of anesthesia may be given.

Good results are to be attained only by careful observation of the patient during the administration of the gas. If she be permitted to pass too deeply under the influence of the gas, the effect is not as good as if she be maintained in the zone of analgesia. If analgesia be permitted to pass into anesthesia, the ability of the patient to respond to suggestion is lost, and she also seems to be more susceptible to pain. Even slight cyanosis is to be avoided and is not necessary. If the woman gets a little too far under the influence of the gas, a whiff or two of oxygen at the conclusion of the pain will rapidly correct any tendency to stupor. If she complains of dizziness or is slightly cyanotic, or the eyes tend to fall shut the amount of gas must be decreased.

In a number of cases, low forceps has been done, although usually ether is used if instrumental interference is needed. Episiotomy and perineorrhaphy have been frequently done. Usually for these procedures and always for forceps, the anesthesia has been deepened to the surgical degree.

While one of the greatest advantages of gas analgesia is that it may be given over a considerable period of time, some of the patients

who have evinced marked satisfaction have been multiparae, who have taken the gas for periods of less than two hours in rapid labors. In many instances these have been patients who in former labors had received but little relief from pain either because ether had been withheld or had been inefficiently given. These women are given relief from the pain of the second stage without increasing the length of labor at all. In primiparae in whom the first stage is long, by the use of a hypodermic of morphine early in the first stage, and the use of gas beginning toward the end of the first stage and continuing through the second stage, a high degree of relief from pain may be attained.

All patients who have taken the gas two hours or more, and a considerable number of the others, were questioned on the third or fourth day as to the amount of relief from pain which they experienced. Many of them said that they were fully conscious of the contractions, but did not feel pain. Almost all of the remainder stated that the pains were very greatly relieved. Only two were of the opinion that the pain was relieved but little. A large number of these patients have said that they were fully conscious of the contractions but did not feel pain. They would clearly remember working and bearing down at direction and would repeat remarks which they had overheard in the labor room, but would not remember pain or would have but a slight remembrance of pain.

So far as our experience has gone, we have been unable to see any danger in nitrous oxide analgesia. Nitrous oxide has long been known as the safest anesthetic when carefully given. It causes no visceral lesions either of the mother or the fetus. Its volatility is so great that the tissues are free of it almost immediately after administration has been stopped after each pain. Its great advantage as to safety for the infant will be at once apparent to any one who has read the report of Graham upon the results of chloroform anesthesia on the young of pregnant animals. While the tissue damage caused by ether is by no means as great as that caused by chloroform, the advantage still rests strongly with nitrous oxide. The safety which statistics have accorded to nitrous oxide has recently been again proved by the work of Woodvatt.

The machine used is a standard one made by a well known firm and fitted with regulators to control the rapidity of the flow of gases from the cylinders to the mask. The expense of administration is well within the reach of families of moderate means. One who has had experience

in administering analgesia will attain good results with a surprisingly small amount of gas. A machine fitted with regulators is much more economical of gas than one without and renders the administration distinctly easier. A number of times one small tank of nitrous-oxide has sufficed for three hours of analgesia. It is perfectly possible to use the method in a private house if a nurse or attendant accustomed to its use is present and the proper apparatus is available. The same firm which manufactures the apparatus which has been used in this series of

cases is at present perfecting a small portable apparatus which fits within a case of a size to be easily carried.

The advantages which have seemed to be most striking are: first, the high degree of safety; second, the fact that relief of pain may be secured without impeding the course of labor; third, that its use may be prolonged for hours, if necessary, and lastly, that the administration of gas analgesia is sufficiently simple that any practitioner willing to devote a little attention to it may readily learn its administration.

A PELVIMETER FOR MEASURING THE PELVIC OUTLET

By F. L. ADAIR, M.D., MINNEAPOLIS, MINNESOTA

Associate Professor of Obstetrics, University of Minnesota

THE importance of recognizing abnormal pelvic outlets is being constantly brought to the attention of obstetricians. Methods and instruments of various kinds have been described for the purpose of determining the size of the outlet of the parturient canal. The earliest and greatest attention was given to the distance between the tubera ischi, more recently attention has been called to the measurement of the anterior and posterior sagittal diameters of the outlet. The importance of the angle of the pubic arch is recognized, but so far little, if any, attention has been given to the measurement of this angle. It is for this purpose that the instrument to be described has been devised.

The instrument, Fig. 1, has three scales, one (A) for measuring the distance from the pubic arch to the tubera ischi, another (B) for measur-

ing the distance between the tubera, and a third (C) for estimating the angle. The instrument is quite easily adjusted and the scales can be read at a glance. Asymmetry of the outlet may be measured with this instrument. The importance of the angle in relation to the transverse diameter of the outlet is shown by the diagram. In Fig. 2, $A-C=9.5$ cm and $D-F=8$ cm.

It is apparent that a spheroidal body such as the infant's head which had a biparietal diameter of less than 9.5 could pass between the tubera. It would, however, require more room in the anteroposterior diameter with a pubic angle of 60° $A-B-C$ than it would with an angle of 60° $A-B-C$. In this instance a narrow angle

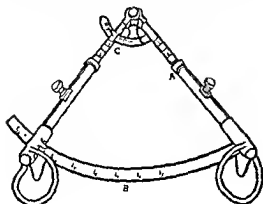


Fig. 1

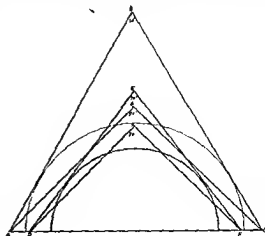


Fig. 2

would be more favorable with a base of the same length. The same would be true with an inferior ischial diameter of 8 cm $D-F$. The angle $70^\circ D-E-F$ might be more favorable than the more obtuse angle $90^\circ D-E-F$. It is also apparent from a comparison of the equal angles $A-G-F$ and $D-H-F$ with bases of unequal length that a larger object could pass through the former.

The circles indicate that it is not sufficient to know the distance between the tubera and the length of the anterior and posterior sagittal diameters but we should also consider the relationship of these measurements to the pubic angle bearing in mind that a narrow angle may be more favorable than a broader one.

It would seem that the distance from the line between the points where the head impinges on

the sides of the angle to the tip of the sacrum would be of more value than the so-called posterior sagittal diameter. If 8 cm. is assumed to be the proper minimum distance, then the posterior median diameter corresponding to the posterior sagittal should be measured from the center of a line extending between points on the legs of the triangle, which are 8 cm. apart. This line might be anterior to the transverse diameter of the outlet. In other words the points where the head impinges on the legs of the triangle may be more important than the distance between the ischial tuberosities.

The narrow angle is unfavorable only in so far as it indicates a short transverse diameter of the outlet. As yet my measurements are too few in number to be of any value for statistics.

DESCRIPTION OF A SELF-RETAINING BLADDER RETRACTOR

By J. C. MASSON, M.D., ROCHESTER, MINNESOTA

From the Mayo Clinic

IN all surgical operations on the bladder, good exposure is a very important factor and to accomplish this a great many instruments have been devised. In our experience the lateral retractors of the Walker type have been the most practical but they have the objection of requiring extra assistants. To avoid this, we have applied the same type of blades to a self-retaining retractor. When the instrument is closed, the upper parts of the blades dovetail into one another to help in inserting. They are attached

to the rest of the retractor by pivot-joints, allowing free movement, which is a great convenience as the body of the retractor can be turned to where it is least in the way of the operator. By spreading the retractor and holding the fundus well back with a long tongue depressor in the hand of an assistant, the operator can see the entire interior of the bladder. The retractor is especially useful for exposure in removing neoplasms of the bladder and in suturing the capsule following the removal of adenomatous hypertrophy of the prostate (Figs. 1 and 2).

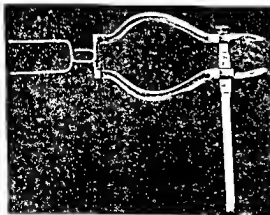


Fig. 1. Instrument ready to insert

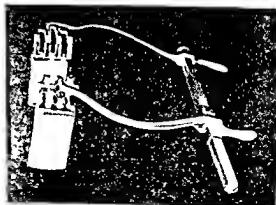


Fig. 2. Instrument in place

THE LOCAL APPLICATION OF RADIUM SUPPLEMENTED BY ROENTGEN THERAPY¹

By RUSSELL H. BOGGS, M.D., PITTSBURGH

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THE therapeutic action of a local application of radium is due to rays emitted, which penetrate the tissues and therein produce certain changes. The character and extent of changes depend upon the quality and quantity of the radiation. Weak radiation may stimulate the cells, while larger doses inhibit cellular functions and finally cause death. Every cell is susceptible to this stimulation or inhibition, but the effect varies in degree with the cells of different tissues as well as with the dosage. Thus the glandular epithelium of the testicle, ovary, breast, liver, spleen, the thymus, thyroid and lymphatic glands is more susceptible than the stroma of the same organs.

Investigations have shown that the rays given off both by the radium and the X ray tube act primarily on the nuclei of the cells and inhibit their power of proliferation before the function of the cell is impaired. Embryonic cells and those which are undergoing active proliferation are the most susceptible. It has been shown that malignant growths are retarded by radiation and become less malignant, although they may not have diminished in size or disappeared. By further increasing the quantity of radiation, the injury becomes more pronounced and the cells are completely destroyed, the rays acting differently on the various type of cells destroying one kind of tissue and leaving the other adjacent tissues intact or so slightly injured that they will completely recover.

The therapeutic action of radium on a new-growth consists not only in the destruction of the tumor cells but also in the change produced in the blood vessels. The endothelial cells of the intima degenerate, the lumen of the vessels retract and finally are obliterated, and consequently the tumor cells cannot obtain the nourishment needed for their maintenance of life and for their proliferation.

When a tube of radium is brought in contact with a growth or is inserted into it, a certain dosage will inhibit the proliferation and finally cause necrosis of the cells nearest it, while further away from the tube the same kind of cells will be stimulated. This observation has been made by many and is a settled fact. The statements made as to the depths in which the cells

are affected vary between two and five centimeters, two and one-half being that which is generally accepted. So radium has its limitations in the treatment of malignancy and must be supplemented by something which will destroy the metastasis in the deep lymphatic glands which cannot be reached effectively by radium rays.

The quantity of rays reaching tissues adjacent to the radium tube diminishes inversely as the square of the distance. The more susceptible a cell is, the smaller the dose necessary for its destruction and consequently the greater the distance at which it may be influenced. Since the effect of the rays decreases as the square of the distance from the radium, it necessarily follows that tissues acted upon must be as close as possible. Whenever it can be arranged, the abnormal tissue should be brought in contact with the radium container, while the normal tissue should be as far as possible from it. When large growths have been treated, it has been determined by biopsy that the periphery of the growth is stimulated by the attenuated rays that are able to reach through, while the malignant cells in the tissues in contact with the radium are destroyed. Many have long realized—since light decreases inversely with the square of the distance—that, if the source of radiation is placed in contact with the skin of the patient, the dose is many times stronger on the surface than at a depth where the disease must be destroyed. The greater the distance the source of radiation is placed from the surface of the body, the more nearly the tissue at a depth will be rayed homogeneously. With an X ray tube placed twenty inches from the surface, a growth situated four inches below the surface will receive almost the same amount of radiation as the skin less the amount cut off by absorption of the four inches of tissue. Some radium workers who have large quantities of radium have placed it at a distance, thereby reaching a more nearly homogeneous radiation than by bringing it in contact with the surface of the body, but until they can obtain many grams of radium this is not any more practical than attempting to treat cancer of the uterus with five milligrams of radium locally and expect results.

¹ Read before the American Roentgen Ray Society, Atlantic City, N. J., September 24, 1913.

As it greatly increases the time of exposure to increase the distance of the source of energy, a roentgen tube should be placed as close as possible without impairing results at the desired depth. The shortest distance can be determined only by the amount of radium radiation given locally and by the amount of cross firing. Of course the loss by absorption must be supplemented by cross-firing.

The general opinion at present is that all malignant tumors are in their early stages merely local, so that a complete cure may be obtained by early and complete removal. Unfortunately no clinician is able to state when such is the case, the facts are quite otherwise. Generalization and recurrence in the cicatrix and the glands frequently follows even when the tumor has been completely excised in its early stage. So frequently is this the case that we are bound to conclude that the disease is regional and not entirely local from the beginning, even before the neoplasm is recognizable by the naked eye, because the whole of the lymphatic circulation as well as the glands are already infected.

This is shown by the fact that recurrence is frequently seen in the cicatrix of an incision at a considerable distance from the original lesion. Leduc states: "For some considerable time after this regional infection by malignant disease, the lymphatic glands are able to defend the organism against the general invasion of the disease. The glands here play a double rôle: they are both fortress and garrison, arresting the invasion, and defending the organism against the entrance of the pathological germs."

If his deductions are correct the surgical removal of the lymphatic glands, even in a very early operation for cancer, is to be deprecated, unless every part of the garrison, i.e., the lymphatic glands, which are holding metastatic cancer cells, is removed at the time of operation. Other wise it removes the only barrier to the invasion and the only defense of the organism, thus hastening the end. We are sure that the surgeons would not operate on a great many cases that they do if the visceral generalization had been as easily recognizable as the local recurrence in the glands or scar, or if they had had these cases treated most thoroughly and radically by modern radiation. An incomplete surgical removal neither prolongs life, retards the progress, nor affords palliation, but rather hastens the progress. This is not true of radium applied locally because the lymphatics are never opened. However, it has the disadvantage of not giving off rays which will act at sufficient distance from

the radium tube to destroy the cancerous cells in all the adjacent lymphatics.

Experience of the past two years has shown that we cannot treat successfully with radium at a greater distance than two or a maximum of three centimeters. It has been universally accepted that cancerous growths can be promptly and also apparently permanently cured at this depth from the radium tube. However, if the disease is advanced and there is infiltration of the growth into adjacent lymphatics, the cure is only apparent. The local growth may disappear, but if metastasis takes place before treatment is given, it will progress, if radiation is effective from only two to three centimeters from the tube, without regard to the quantity of radium applied or to the length of time it is applied.

Larger quantities of radium have been tried and the time of exposure increased so as to influence cancerous cells at a greater depth, but the universal reports show that not much success has been accomplished in this direction. The overlying tissues were damaged beyond recovery regardless of the kind of filters employed. The rays of the radium in contact with the growth were too intense where it entered and too weak at a greater distance from the tubes than from two to three centimeters. Placing the radium at a distance from the surface so the rays would be nearly uniform at the point of entrance and at the distance required renders the radiation too weak even if several grams are employed. The same is not held true of the present X-ray tube which, when powerfully excited, gives off many thousand times more rays than any quantity of radium any one has ever used. It has been estimated that ninety-two grams of radium would be necessary to place the radium at the same distance in order to obtain at a depth of ten centimeters the same intensity of radiation as with the X-ray tube.

Warnekros, in order to compare the relative quantities of the rays from an X-ray tube and radioactive substances, introduced Kienboeck strips into the vagina of patients suffering from carcinoma and rayed the abdomen by roentgen tubes at a distance of twenty-two centimeters from the skin. A partial account of these tests is given in the *Archives of the Roentgen Ray*, May 1915, which is very instructive. Blum and Warnekros concluded as follows in regard to the hard roentgen rays on deep tissues:

We estimate that, in the treatment by roentgen rays of visible malignant growths one needs a quantity of about 300 to 500 X, in order to destroy and heal growths of two centimeters thickness. The same quantity of 300 to 500

X must reach the depth of tissues if deeply situated cancerous tissues are to be destroyed. The depths which come into consideration reach to about ten centimeters. Our experiments and observations, on dead and living persons, show that at a depth of ten centimeters, when huenboeck strips are introduced into the cavity of the vagina and are subjected to radiation from the outside of the abdomen, the intensity diminishes from 100 to 15, that is to about one seventh of that at the surface. To obtain, at a depth of ten centimeters, 500 X, we must give to the surface 3500 X, and in order to apply this great quantity without serious damage to the upper tissues, only hard rays must be used with a sufficiently large distance from the skin, according to the principle of homogeneous radiation by C. Dessauer, and the rays should enter the body through different parts. Our experience shows that all this is possible and that it produces the same results in deep-seated cancers as are obtained in superficial growths.

In the treatment of any form of malignancy, the proper quantity of radiation must reach the diseased tissue, otherwise good effects cannot be obtained. Clinical experience has proved again and again that permanent results mean more than the superficial treating and removing of the visible part of the disease. Cures by such treatment are only apparent, with relapse in a short time. Attempts to cure malignant tumors with inefficient radiation has lead only to incomplete success. The roentgen rays have been found to be the only agent which is capable of checking and permanently curing well-established malignant growths in which extensive involvement has taken place, although radium is far superior in its local action on any mass situated in cavities where it is necessary to concentrate the rays. Therefore, radium applied locally, supplemented by roentgen rays to the adjacent tissue gives the ideal form of radiation because all the malignant cells can be more strongly rayed with less injury to the healthy tissues. This is a fact beyond dispute. It has been proved without doubt that many cases of inoperable cancer of the uterus have been apparently cured by radium alone applied in the vagina, and also that not our present roentgen methods alone, but a combination of both carried out scientifically seems to be the practical method and should cure more advanced cases than either alone.

Both surgery and radium are local methods of treatment and metastases in distant parts are beyond their reach in a large majority of cases. The disadvantage of surgery is that it removes a large amount of healthy tissue as well as the abnormal. There is always a limit to the removal of normal tissue in that the vitality of the patient is interfered with and consequently metastasis of the malignant cells left in adjacent tissue is hastened. The advantage of radium is that it

will destroy the malignant cells without injuring the normal. It does more than cautery or removal. It destroys the cancer cells, leaving the healthy tissue. The disadvantage is that, with any known technique, the rays do not reach beyond a certain depth and, while the disease in the superficial layers is destroyed, it is only inhibited or unaffected in the deeper parts. This shows the necessity of using radium in cavities, cross-firing as much as possible, or inserting the tube into the growth and raying the adjacent lymphatic supply as thoroughly as possible. We are still looking for the homogeneous ray. I believe that radium is the ideal form of radiation for a depth of two and one half centimeters. We are expecting that in the near future Professor Coolidge will invent a tube which will give us this form of radiation. It is in this direction we are looking because surgery has about reached its limit. While the radium workers' results have been wonderful since filtration and cross firing have been used, they realize that until large quantities of radium have been obtained, this form of radiation has about reached its limit.

Before this society it is unnecessary to go into detail in describing the value of homogeneous radiation and how to obtain it. But I wish to call attention to the fact that most of the radium institutes are not treating the metastases with roentgen rays, and for this reason their results are inferior to those secured by many of the Germans, who never use radium alone in advanced cases. Do they not know the limitations of radium or the value of roentgen therapy? This, I believe, is one of the reasons why many of the radium reports read thus: "This caused the disappearance of the growth. One year later the patient died of metastasis without recurrence." It appears that these radium workers are in the same place that the noted surgeon Gross was when he made the statement that he had not cured in twenty five years a case of cancer of the breast by the removal of the breast. During the past three years I have frequently seen cases of cancer of different parts of the body which have been treated by radium which would bear out this statement.

In epithelioma or carcinoma of the tongue, mouth, throat, lower lip, uterus, or rectum, the disease is seldom seen and diagnosed before the adjacent glands are involved. In many cases the glands are not palpable but metastasis takes place long before the glands can be detected by palpation. This is something every physician should know by this time with the amount of emphasis most authorities have placed upon this

fact. Even some well-informed surgeons will tell you that they have removed all carcinomatous tissue and that post radiation would be superfluous. It is absurd for any one to be guided by the tactile sense in determining whether there are cancer-cells in the adjacent lymphatics. Sad experience in the past has proved this to be a fact.

It is becoming a universal fact that the removal of a cancerous growth locally and as much of the adjacent lymphatic tissue as is possible or the disappearance of the local mass by radiation is a contradistinction to a cure. This might be considered a clinical cure, but a cure means the permanent removal of a malignant growth and its non recurrence in any other part of the body. The rationale of the complete removal must include modern radiation, because even in the very early cases complete removal by surgery, no difference how early and how radically performed, removes the disease in only a certain percentage of cases. A continued study of the lymphatics in their relation to carcinoma for over twenty-five years has lead to more radical operations for their removal and has increased the numbers of cures by surgery, but still the most radical methods will cure only a fair percentage of the early cases. Bloodgood states that when deep-seated cancer is clinically malignant it is usually hopelessly inoperable. The many long and tedious operations for cancer of the breast, the most radical operations for cancer of the uterus, bladder, rectum, and throat must at least be supplemented by modern radiation which makes it more radical in order to cure the highest percentage of cases. The members of this society who have been advocating the addition of radiation to surgery, should at least be gratified that they have succeeded in convincing the best surgical authorities of this fact. Many of the surgeons realize this more fully than some of the members of our society, who are making roentgen examinations of the highest degree and doing very little radiotherapy. Our society has done much in the past and has much to do in the future to standardize methods and educate the medical profession.

The latest surgical authorities recognize the value of modern radiation as a necessary adjunct to operation and as a palliative procedure in the hopeless cases. In this connection let me cite several paragraphs from Johnson's *Surgery* just issued.

Extensive indurated cutaneous epitheliomata involving the subcutaneous and underlying tissue, even with bony involvement, are as successfully treated by massive doses of light, moderately filtered radium as by surgical inter-

vention and, when successful, with far better cosmetic results. . . . Inoperable lesions can be regularly reduced and the pain and discharge diminished, and latterly, with the larger amounts of radium at our disposal, a total disputation has occasionally resulted with a fair prospect of permanent relief.

Inoperable tumors can sometimes be made operable and a cachectic general condition can often be greatly improved by radium applications to the offending mass or masses. The increasing success as shown by results reported in the more recent years, undoubtedly has been due to a concentrated effort to project greater masses of rays more equally distributed throughout the tumor and the immediately surrounding tissues.

Epithelial cancers of the uterus, rectum, and breast have seemed to be more influenced by radium treatment than the other inoperable or recurring epitheliomata.

Carcinoma of the cervix and uterus is anatomically well situated for radium applications, owing to its tendency to spread around the walls of the organ, leaving the cavity of the vagina, cervix, and uterus patent for the insertion of radium tubes on various applicators or in catheters. A 50 mg. tube of the element filtered with 2 to 4 mm. of foil and left in place for 24 hours will relieve pain, hemorrhage and discharge and, in a few rare cases, the lesion has entirely disappeared over a period of months after radium treatment, the cervix and uterus tending to resume somewhat their original contour and appearance.

Such applications to inoperable carcinoma of the rectum have occasionally prolonged life for months and even years and saved the patient the discomfort of an artificial anus.

The symposium on "Cancer of Certain Pelvic Organs," read before the Massachusetts Medical Society, June 9, from a clinical standpoint, should be studied by every one interested in the treatment of malignancy. This symposium emphasizes the importance of more radical operations than have been heretofore performed for carcinoma of the pelvic organs, or else it suggests the addition of radium and the X-ray or some unknown treatment before it can be said we are able to cure a majority of cases which can be diagnosed clinically. The surgeons who took part in this symposium were not only of the highest rank, but each had specialized and directed his attention to only one of the pelvic organs. For the past two and a half to three years in the Massachusetts General Hospital all the cases of cancer of the uterus have been assigned to Dr. Farrar Cobb for operation, and all the cases of cancer of rectum have been assigned to Dr. Daniel Fiske. This has undoubtedly allowed each to perfect his technique to a high degree and their statements are worthy of very careful consideration. Cobb's description of the Wertheim operation in the following words certainly should prove to us that applying radium locally in the vagina would not eradicate the metastases in the adjacent glands when the removal of the tissue at such great distance from the local growth is found to be necessary.

The radical abdominal or Wertheim operation is con-

cise the removal of the uterus and a liberal portion of the vagina through a median abdominal incision, with thorough dissection of the uterus and bladder, with removal of as much of the parametrium on both sides as possible, the regional lymph glands being removed only if palpably enlarged. The operation is a difficult and tedious one and the medical profession and public should be made to understand that it is an operation to be attempted only by surgeons especially interested and trained in this work.

Since, according to Cobb, 50 per cent of the cases of cancer of the uterus come too late for curative operation, and of the operable cases only 50 per cent are cured and there is an operable mortality of from 9 to 30 per cent and so much can be accomplished in the hopelessly inoperable cases, it does not seem presumptuous to suggest that each cancer patient should at least be given the benefit of modern radiation. This certainly shows that Cobb considers the ordinary operation incomplete when he advocates such a radical operation as can be done only by the most skillful and especially trained surgeons. Even then the immediate mortality in a series of cases reached as much as 25 to 30 per cent. Such a radical operation in selected cases cures only 50 per cent of the cases operated upon. His address to any one who is at all familiar with the results of modern radiation, strongly advocates radium applied locally and the raying of the entire lymphatic supply of the pelvis by the most efficient roentgen methods. Until a better cure is found nothing less should be accepted as a standard or routine, and failure to do this should be considered as much a criminal neglect as failure to use the ordinary necessary aseptic precautions.

In this symposium Dr. Daniel Fiske gave the statistics of the Harrison-Cripps cases to show how absurd it is to talk about carcinoma of the rectum as a benign condition. The statistics are as follows:

He saw 415 patients and operated upon 107 of these 107 cases 17 per cent died from the effects of the operation and 40 were alive five years after the operation that is 9 per cent of the total number seen. It would be fair, I am sure, to say that not more than 5 per cent would be alive at the end of ten years.

In this symposium Dr. Arthur L. Chute states

The story of carcinoma of the bladder is most discouraging when we consider the small number of cures that we effect by means of operation. Just enough cases remain well after operation to allow us to say that cancer of the bladder is not absolutely hopeless and to spur us to renewed effort in the hope that when we have a clearer understanding of the condition our results will be better.

Dr. Chute adds.

It has been held that metastasis takes place late in cancer of the bladder. I doubt if this is necessarily so. I be-

lieve that operations cannot in most instances be considered radical, unless we take into account this lymphatic involvement. I believe the condition is probably this: that so long as a growth is confined to the mucous layer of the bladder there is probably no lymphatic involvement, that the moment it invades the deeper layers we have lymphatic involvement.

If it were possible to make an early diagnosis when only the mucous layer of the bladder is involved it would seem possible that such conditions could be promptly healed by radium. A few good results have been reported, but unfortunately these cases are usually diagnosed late and it is more difficult to apply radium to the bladder than to almost any other organ in the body. The danger of setting up an obstinate cystitis is always to be remembered. From studying the lymphatic supply of the pelvic organs it is readily seen how difficult, if not impossible, it is to remove the adjacent glands involved at the time of operation, no difference how radically it is performed. It is usually impossible to remove all the glands affected. The question when operating is, if the glands are affected, where are we going to stop?

A thorough study of this symposium on cancer and metastasis in general shows us why such free thinkers as Bumm, Döderlein, Kelly, and other noted gynecologists have adopted the use of modern radiation as a routine method in all their cancer cases, at least post operatively. It is only a question of time until the entire medical profession will come to the same conclusion. The following is Kelly's report in the *Maryland Medical Journal*, July 1915:

In nearly thirty per cent of the inoperable cases even the disease has disappeared under efficient radiation with large amounts of radium element. This was true in a group of over two hundred cases treated by Dr. T. J. Burnam and myself. It is a common sight to witness too, the disappearance of a growth recurring in the vaginal vault after operation. It is a question for the next three years to settle whether we will continue to operate on any of the group of cases which melt down under our radium therapy.

Up to the present radium has been used repeatedly to shrink an inoperable growth and then to operate radically.

It is not necessary to quote the results of the work which has been done and reported to members of this society. It would be well if our members would refer physicians interested to one of the many articles which have thoroughly reviewed the literature. There is an excellent article by Henry Schmitz in *Surgey, Gynecology and Obstetrics*, January 1915, which has undoubtedly been read but not considered sufficiently by all the gynecologists. There can be no doubt in regard to the benefits derived from modern radiation if properly given in conjunction

with surgery. The probability explaining one of the causes leading to neglect in using post-radiation is that usually too much is asked of radiation. Too often in the treatment of cancer all we see is the surgical removal of the line of defense, leaving the lymphatic glands of the adjacent tissue, which cannot be removed, untreated until a marked or clinical recurrence has taken place. Even in such instances, however, the disease is retarded, the pain relieved, and the foetid odor diminished in a large percentage of cases and a clinical cure obtained in some cases.

During the past nineteen months, I have had a limited experience with radium in cancer of the uterus. Of fourteen cases treated, ten were recurrent and the other four were so far advanced that they were beyond the operable stage. All improved except two, in that the disease was checked, the growth diminished in size, the pain relieved and the offensive odor lessened or entirely checked. Three have been clinically cured, and one, which is still apparently cured, I reported before this society a year ago. In two other cases the disease has nearly all disappeared. These results are remarkable when you consider all were hopeless as far as any other treatment was concerned, and that four cases were taking heavy doses of morphine when they were referred.

In this connection I will report the following:

Mrs. D, age 33, was referred to me by Dr. Werder for a recurrent carcinoma following a radical operation for carcinoma of the cervix. The recurrence was marked in the vaginal cicatrix, and the hemorrhage and discharge were excessive. On account of her age and the rapid spread of the growth, she was considered a very unfavorable case. At the first treatment she was given 2,000 milligram hours of radium and this was repeated four weeks later. Following the first radium treatment she was given radiotherapy over the anterior abdominal wall, back, and perineum, the same method as used by Kroenig and Gauss in treating fibroids of the uterus. The same amount of roentgen radiation was given again after the second radium treatment. Four weeks later Dr. Werder examined the patient and stated that he was unable to detect any disease and considered the case clinically cured. She was again given another radium treatment, supplemented by roentgen therapy, as a prophylactic measure.

Mrs. F. was referred by Dr. Gardner who stated that he saw the case for the first time three weeks prior and that she gave a history of having had hemorrhages for at least two years. At that time she had consulted a physician who told her that the ulceration might be the beginning of cancer. Following this, she had not seen a physician until the pain had become so severe and the discharge so offensive that she consulted Dr. Gardner, who referred her to me for radium treatment. Some of the necrotic tissue was destroyed by cautery, after which she was given 3,000 milligram hours of radium with heavy roentgen treatment as described before. At the end of two months all the cancerous tissue had disappeared except a small

area, which entirely disappeared six weeks later. She was given additional prophylactic treatment and is apparently cured, but the time is entirely too short to give any prognosis.

I have not had as good results in the treatment of carcinoma of the rectum or bladder. However, sufficient results were obtained to offer this method of treatment as a palliative measure in the hopelessly inoperable cases and with the possibility of a cure, or at least further increasing the number of cures in conjunction with surgery. Three of the rectal cases were greatly improved and great palliation was obtained. In one advanced case the palliation was remarkable in that the mass was reduced in size and the patient had normal bowel movements for six months after the radium treatment.

As a whole, my results in the treatment of malignant growths of the throat with radium, have been very gratifying when considering the hopeless condition of these patients when they were referred. All were far advanced and operation had been refused except, of course, in some of the cases which were treated post-operatively. One case of carcinoma of the tonsil was reported in the *New York Medical Journal*, July, 1915. Another case which was greatly improved and in which all the disease disappeared was given additional treatment, until finally the surrounding tissues broke down, producing an infection of the throat, and while the patient did not recover, I do not believe she died of carcinoma. This case I believe would have done much better by treatment in small divided doses than by the heavy massive dose. A case of epithelioma of the inside of the cheek has been apparently cured for nine months. This case responded in a remarkable manner and the ulceration healed, leaving very little deformity. An epithelioma of the palate showed marked improvement at first, but later broke down and did not respond to further treatment. I might cite a number of cases treated, but the few mentioned briefly will suffice to illustrate my points in this paper.

The cases of epithelioma of the tongue which I have treated were all advanced cases with the usual involvement of the sublingual glands as well as with deeper metastases. While encouraging results were obtained, i.e., the local lesion decreased in size and the metastases were checked in nearly all, in only one case did the local lesion entirely disappear. So far I have not treated a favorable case and can speak only of the cases far advanced which were hopelessly inoperable. Cancer of the tongue and buccal membrane is

less influenced by radium than cancer in almost any other situation. This is not entirely due to the greater lymphatic supply, with a consequently greater tendency to metastases and the difficulty often in making prolonged applications, but it appears that there is not the same difference between the relation of abnormal and normal tissues. In order to give sufficient radiation to destroy all the cancer-cells, greater care must be exercised to avoid injuring the healthy tissue beyond repair. The same caution is not necessary in the treatment of cancer in most other situations. Also the muscles are early infiltrated in epithelioma of the tongue and infiltration of the muscle makes the disease more resistant to radiation. From the experience I have gained in the treatment with radium in such cases the results are better when the treatment is given in divided rather than massive doses. This allows the normal tissue to recover. However, in all cases except epithelioma situated on the tongue, throat, or in the rectum, I would advocate massive doses given as quickly as possible. Then it naturally follows if this is true that you are unable to give as much radiation, and the same comparative curative results cannot be obtained in epithelioma of the tongue.

In epithelioma of the lower lip, radium supplemented by roentgen therapy is a perfectly legitimate method of treatment, provided the cases are selected by an expert and the operator is qualified. I believe this will give equally as good if not better results than the removal of a section of the lower lip with the sublingual glandular tissues. With our present methods of roentgen therapy it is reasonable that the disease in these lymphatics can be eradicated in more cases than can be done by surgery.

At the meeting of this society three years ago at Niagara Falls, I quoted a paragraph from Murphy in regard to epithelioma of the lower lip which I believe will bear repetition.

In a series of cases published, 52 per cent of the patients who had carcinoma or epithelioma of the lip, without any demonstrable metastasis at the time of operation, died of cancer, and 75 per cent of the patients who had any demonstrable enlargement of the glands at the time of operation died a cancer death.

In the inoperable epithelioma of the lower lip the growth can be regularly reduced in size and the pain and discharge diminished, and in some cases the disease has entirely disappeared with a fair prospect of a permanent cure. If the lesion is removed by surgery, on account of the great lymphatic supply, all the glands cannot be removed down to the mediastinum, so radio-

therapy should be used as a prophylactic measure at least.

It is necessary for the operator to know the relative value of radium and the roentgen rays when combining these two agents. In carcinoma of the uterus, for instance, nothing could be expected from a local application of radium with less than from 2,500 to 5,000 milligram hours, using nothing less than 50 milligrams of radium element. Then after a rest of three to five weeks another course of treatment is usually necessary. When roentgen therapy is added it should be given in the same manner and quantity as it is used for the treatment of fibroids. How often both forms of radiation is to be repeated must be determined by the judgment of the radiotherapist who must be a clinician, because he cannot be entirely guided by the surgeon who is not familiar with any form of radiation. To secure permanent cures the effect of the radiation must extend from the primary growth out to the metastases and the deleterious effect on normal tissues avoided.

DISCUSSION

CREVALIER JACKSON. A number of years ago I did many operations for malignant disease about the nose, mouth, and fauces. Since narrowing my field of work to endoscopy and laryngeal surgery, I no longer do any operation in the regions just mentioned, but long before narrowing my field of work I had refused to operate upon malignancy, because my results had been so bad. The cases were so uniformly subject to fatal recurrence that I did not deem operation justifiable. Therefore, I am in a position most heartily to endorse and welcome the advent of the beautiful work that is being done by Dr. Boggs and other members of this society with the roentgen ray and with radium in the treatment of malignant disease of the nose, mouth and fauces.

Now let us consider for a moment malignant disease of the larynx. Nowhere else in the human body has the surgery of malignant disease yielded such brilliant results as in thyrotomy (or laryngofissure) for malignant disease of the larynx, provided the operation is limited strictly to operable cases. In using the word operable no reference is had to the question of the patient surviving the operation. The important question is as to recurrence, and any case in which recurrence is likely should be considered an inoperable case. As demonstrated many years ago by Sir Ellis Semon, operable cases are those in which the growth is strictly intrinsic and of very limited extent. Semon obtained 85 per cent cures by thus limiting his operations. His results have been equalled by Sir St. Clair Thomson, Mr. Tulley, myself, and others who have followed Semon's footsteps in the selection of the case for operation. Unfortunately, however, cancer of the larynx is relatively very rarely discovered early enough to permit of cure by operation, either because there has been no symptom that the patient noticed early or because for some other reason, the patient's larynx has not been examined laryngoscopically. The last time that I added up statistics of cases seen by myself in 27 years, I had done only 37 thyrotomies out of 211 cases of laryngeal malignancy. Unfortunately it requires a great deal of courage

to say "hands off" and, also unfortunately, the surgeon yields to his natural impulse to give the patient a chance, even though remote, of cure by operation, when dealing with a case like cancer of the larynx which, if left alone, yields 100 per cent mortality. But these cases that are inoperable should be dealt with by radium and the roentgen ray as advocated by Dr. Boggs.

HENRY PANCOAST. Anyone using radium for therapeutic purposes must thoroughly understand and constantly bear in mind the therapeutic action of the radiation emitted—that cells are susceptible to stimulation, inhibition of function or reproduction, or destruction, and that the administration or the dose must be of such quantity and quality as to induce the effect that will bring about the desired result.

Both roentgen rays and radium rays are employed in certain conditions for their stimulative effect, because a stimulation of the tissues is the effect that is necessary to bring about a cure. Dr. Boggs' paper deals particularly with malignant disease and one might on first thought imagine that stimulation could be disregarded in this connection because it was an effect that was not desired in treating malignancy. This effect of radiation is, however, a most important one to consider for the reason that it is a very difficult one to avoid when we do not require it. I am a firm believer in the possibility of stimulating malignant growths, although I realize that there are many who are opposed to such a view. I believe that in inexperienced hands the stimulative effect of radium radiations may be readily produced, especially at the periphery of a growth where cell proliferation and the spread of the neoplasm are the most active and dangerous, and in metastases. Unfortunately, this effect is too often unwittingly produced by those of the widest experience. It is just as important that these portions of a growth receive destructive dosage as any other part.

One of the most important points brought out in Dr. Boggs' paper, is his statement of the generally accepted knowledge that where complete necrosis of tissue may be caused by radium just at the point of its application, the destructive effect does not appear to be exerted further than 5 cm on an average from that point. Beyond that distance, therefore, either stimulation may be induced, or the effect is so slight as not to seriously interfere with malignant cell proliferation. As a concrete example for the application of these facts, let us take a case of inoperable carcinoma of the uterus with extension into the broad ligaments and possibly with lymphatic metastases.

How foolish it is to expect a permanent cure from the application of radium to the cervix, even though we may obtain a most gratifying temporary local result, if the malignant cells proliferating at a distance beyond 2.5 cm in the primary growth or in metastatic deposits cannot be destroyed. We have accomplished no more than a localized destruction in a widespread growth. Such treatment is frequently followed by a more rapid invasion of the surrounding structures.

Further discussion would be unnecessary if we were obliged to stop here because we had reached the limit of our possibilities, but such is not the case. There is still one very effectual agent to be used and one that is too frequently disregarded by those who employ radium alone. If additional and completely effectual radium applications cannot be made at other points, an additional effect may be produced by cross-fire roentgen radiation, the object of which is to intensify the action of the radium radiation beyond the point where its destructive effect ceases. In the case of uterine carcinoma when there is the least suspicion of extension beyond the limit of control by radium it would certainly seem as though our patient had not received adequate treatment unless the radium applications were supplemented by such cross fire roentgen radiation as is employed in the treatment of a uterine fibroid. Each agent alone has accomplished some good results but both together should accomplish far more.

Cancer of the rectum has not responded nearly so favorably to radium treatment as has carcinoma of the uterus. I do not believe that a growth in the rectum can be properly and adequately treated unless a preliminary colostomy is performed. At least this is so in the large majority of cases, and this fact is not nearly so fully realized as it should be. Without the operation, we are prevented from pushing the treatment as energetically as we should because of the discomfort of the patient due to the effect of the radium on the mucous membrane of the bowel and the continuance of the function of the part. Discomfort is often greatest in the sphincter region, and when this area is invaded, the treatment must be most vigorous because of the greater likelihood of metastasis.

Our experience has been entirely in accord with that of Dr. Boggs in connection with cancer of the tongue, throat, and rectum. Too vigorous radiation is to be avoided because of the danger from extensive devitalization of healthy tissues. The dosage should be much less at one time, as a rule, than in uterine carcinoma, and should be divided and repeated.

CAUSES, MECHANISMS, AND TREATMENT OF FLAT-FOOT

By WILLIAM JACKSON MERRILL, A B, M D, PHILADELPHIA

Instructor in Orthopedic Surgery University of Pennsylvania Assistant Orthopedic Surgeon, University of Pennsylvania Jewish and Howard Hospitals, Consulting Orthopedic Surgeon to Genesaw Hospital

ALTERATION in the normal poise of the body which gives rise to pain and tenderness in strained muscles and ligaments is a disorder too often not recognized, the condition is frequently mistaken for "rheumatism" and inappropriate treatment is often administered. The distressing symptoms that are found in the early stages of flat-foot and pronation can almost without exception be traced to some systemic cause as a predisposing factor. Toxic conditions arising from altered physiological processes, infections, etc., predispose to pain and weakness in muscles and ligaments owing to the increased irritability of the cellular elements, consequently physical structures under the influence of this abnormal state, in performing their normal functions, will show symptoms of overstrain.

When the arch is obliterated, the toes abducted, and the patient walks with that peculiar limping gait, the diagnosis is apparent even to the layman. In the earlier stages of flat-foot a keener insight is required to determine the significance of a slight decrease in muscular tone, a minute alteration in structural relationships, and slight changes in the weight-bearing postures. Moreover, in the incipient stage when time can be saved and best results can be obtained, skill and good judgment in the construction of the proper shoe are most essential.

The causes of flat foot are the conditions which alter the structural relationships and lessen the power and tonicity of the muscles and ligaments. If the general musculature becomes flaccid, the muscles or groups of muscles that receive the greatest amount of strain are the first to give way. In the treatment of the malady in question therefore, it is important to make a thorough study of the mental, nervous, and physical status of the patient, acquiring an intimate knowledge of the condition of the circulatory, genito-urinary, gastro-intestinal, and respiratory systems, and to study the effect of any superficial glandular infection present and of the mode of life, since careful observation has found constitutional conditions to be primary factors. The next step is to study the positions in weight-bearing. The vicious habit of toeing-out is a very general cause.

In this position the toes fall far outside of the

plane of weight-bearing, the force of the body weight in walking is oblique to the arch of the foot and an inward cross strain is produced. The position of the leg in which the toes fall outside of the line of progression shortens the stride, lessens the important element of thrust of the great toe, and diminishes the force of propulsion. Persons in whom this toeing out position is exaggerated have a peculiar trudging gait and readily become fatigued in walking. It is an astonishing fact that a wide divergence of the toes has been a custom ardently insisted upon for many years, the military rule and the custom in many physical training institutions has been a divergence of the toes in standing of from 60° to 90°, and in walking a divergence of about 45°. When the weakness of this position, the loss of propulsive power, and the diminution of the stride are considered, the reason is apparent why athletes, and savages toe in from a natural conservative impulse. The toeing-out position affects not only the foot but also the superimposed structures. The legs are externally rotated, the knees are subjected to a twisting force, and the joints are strained. The outward rotation of the femur favors a backward rotation of the pelvis on its transverse axis with elevation of the pubis and a consequent decrease of the normal lordosis. In addition, the hips and shoulders are displaced forward, the lower thoracic curve is increased, and a stoop-shoulder position is favored. The converse of this condition is absolutely true. The toeing-out position also is a potent factor in the development of hallux-valgus, because the cross strain combined with narrow toes of shoes and stockings, drives the toe outward at every step.

Shoes which hold the foot in constrained positions produce painful callosities, deranged relationships, disturb function, and are a fruitful factor in the production of flat foot. The wearing of ill-fitting, badly shaped shoes, especially with high heels and tight laced constricting uppers, and narrow toes, places the foot in a cramped malposition, prevents free normal action and produces muscular weakness, atrophy, and the loss of tonicity. Many persons who wear this type of shoes have severe pain when they attempt to walk without shoes and in many cases standing with the feet in a normal position is impossible.

Occupations unassociated with other predisposing conditions, in rare instances produce muscular weakness and flat-foot in normal individuals.

Local and pathological processes, trauma and congenital defects, each have a significant bearing on the causation of flat foot. A shortened tendo achillis which diminishes the flexion of the foot on the leg in walking, tends to weaken the tarsal structures; if pronation of the foot and abduction of the toes do not compensate the loss in flexion, the arch gives way. The cause, whatever it may be, bears a direct relationship to the deformity.

It is well to bear in mind the anatomical and mechanical features found in normal subjects. The normal position of the lower extremities in bearing the weight of the body is such that a plane passing through a point in the anterior superior spine of the ilium parallel to the line of gravity will pass through the patella, the lower end of the tibia at its malleolus, will coincide with the inner surface of the os calcis, and pass through the axis of the second toe. Obviously the superimposed weight falls to the inner third of the heel and must be borne chiefly by the supinator muscles. The long plantar flexors of the toes exert a force between the os calcis and the phalanges which tends to approximate these structures, gives added support to the longitudinal arch, and adds stability to the foot. The force of the tibial muscles fixes the scaphoid against the astragalus, gives stability to the latter, prevents its downward and inward movement and a pronation of the foot. The astragalus secured by the malleoli has but slight lateral movement. Normal pronation and supination are made possible chiefly by movement between the astragalus and os calcis and the astragalus and scaphoid. The weight of the body is transmitted to the ground through two pillars: one, the comparatively small undersurface of the tuberosity of the os calcis, the other, the distal ends of the metatarsal bones and the phalanges. These two pillars support the longitudinal arch. The point of bearing of the former is fixed, the latter support is movable and pliable, giving control in equilibrium and resiliency to the stride. The obliquity of the plane of the mediatarsal joint causes a lateral movement of the toes in dorsal and plantar flexion of the foot at this mid-joint. There is a wide spread conception that the distal heads of the metatarsal bones form an arch which has a bearing point at the distal tuberosity of the first and fifth metatarsal bones. This is an erroneous impression since in most feet in the weight-bearing

posture the heads of all of the metatarsal bones transmit weight directly to the ground; consequently, conditions ascribed to the falling of the anterior arch are due to other causes. With the foot and leg in the normal weight-bearing position, the great toe is directed slightly inward. This relationship is generally found in non-shoewearing people. Their arches are normally low but give no subjective symptoms; the antatarsus is broad, the toes are straight, and the muscles controlling them are well developed. The second toe is directed straight forward. Each toe has an unrestricted action in performing its function and adds its important rôle to the stability of the foot. Flexibility of the feet and toes is imperative in correction of altered structural relationships and in maintenance of correct balance.

The mechanism of altered relationship and disturbance in function depend upon the structures affected. If the force of the tibial muscles is diminished, the support of the tarsus is lessened on its inner side and pronation results without alteration in the contour of the arch if the plantar structures are normal. In cases of marked relaxation of the tibials associated with relaxation of the internal lateral ligaments, the head of the astragalus moves inward, by virtue of its increased freedom, it rotates forward and downward and is tilted inward, the os calcis rotates inward on its longitudinal axis, tends to rotate inward on the vertical axis, weakness of the plantar structures occurs, the arch is diminished and the condition of talipes valgus is produced. If the plantar structures are weakened or relaxed and the tibial muscles prevent an inward movement of the tarsus, the normal arch is diminished, the foot anterior to the mediatarsal joint is abducted and talipes planus results. When there is diminution in the normal power of the tibial muscles and plantar structures, the arch tilts inward and is diminished vertically according to the loss of muscular and ligamentous support and *plano pronatus* is produced. Likewise combinations of the various malpositions may be found.

Symptoms are manifold and pain resulting from foot strain may be found at almost any level of the body mechanism. Symptoms may be local, as pain or tenderness or both in strained muscles, ligaments and tendons, or they may be associated, as pain or tenderness or both in the knee, hip, spine, etc., owing to the strain resulting from static disturbances. Again, pain as a result of irritation of the terminal branches may be referred along the nerve trunks even to the spinal roots. Changes in structure are frequent

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Symptoms are manifold and pain resulting from foot strain may be found at almost any level of the body mechanism. Symptoms may be local, as pain or tenderness or both in strained muscles, ligaments and tendons, or they may be associated, as pain or tenderness or both in the knee, hip, spine, etc., owing to the strain resulting from static disturbances. Again, pain as a result of irritation of the terminal branches may be referred along the nerve-trunks even to the spinal roots. Changes in structure are frequent

occurrences as traumatic arthritis of the knee-joint, deformity of the head of the femur, scoliosis, altered position of the shoulder girdle, etc. The unequal wearing away of the sole and heel of the shoe, the characteristic posture, the trudging gait, mental apathy, early fatigue, etc., are factors which guide the diligent, not only to the nature of the condition but especially to the cause.

In methods of treatment there has been a great diversity of procedure, but fundamentally a simple rule can be deducted—the partial or complete removal of the cause and the establishment of conditions that tend to restore normal muscular power and tonicity, and a normal poise of the feet as well as of the body. The nature of the treatment must necessarily consist of measures that will meet the needs of the conditions found. Unfortunately, foot troubles are overlooked or neglected until more complicated conditions transcend the first simple disability, nevertheless a limited experience in the management of foot disorders has convinced the careful observers that the only rational procedure is the restoration of normal function by the removal of the cause of the disability and the establishment of normal conditions, not by the support of weakened structures. Any condition that lessens the general tonicity must be removed and that loss in tonicity restored by medication, good food, and proper hygiene. Muscular power must be increased by exercise, massage, heat and cold, electricity, passive motion, etc., as indicated. The poise of the body in standing and walking must be so regulated as to suit the individual case. When occupation is a contributory factor it must be modified as much as possible to mitigate its effect. The proper construction of the shoe is most important in the establishment and maintenance of normal weight-bearing conditions. The shoe must not interfere with the functions of the foot. The heel should be high enough to suit the needs of the individual case. The sole should be formed so as to adduct the anterior part of the foot, applying pressure along the outer side of the fifth metatarsal bone, not to the toes. The inward flexion will then take place at the metatarsal joint, the foot being held in a straight line forward from this point, thus throwing the center of gravity to the outside of the foot and increasing the arch. The sole should be broad enough to allow a requisite spread of the toes in the free performance of their function. The counter should fit the heel of the foot closely and hold it securely. The upper should fit accurately but should not constrict the ankle. A tight upper impedes the circulation, favors congestion

and atrophy of the structures below, and hampers the action of the tendons at the ankle, and as well restricts the function of the foot. In designated cases a wedge in the inner conformation of the heel aids materially in maintaining the foot in the proper position of weight bearing. The wedge should give the proper tilt to the individual foot and be removed after it has served its temporary purpose. There is rarely any indication for wedging the inner conformation of the sole since the object of the wedge is to tilt the os calcis outward and correct the tarsal torsion which has taken place. If both heel and sole are tilted outward the position of the os calcis and ball of the foot remain relatively the same and the purpose of the mechanical principle is lost. A Thomas heel is often serviceable in bolstering up the os calcis and in preventing an inward rotation on its longitudinal axis. When a rigid flat-foot, a shortened tendon, paralytic or traumatic conditions are encountered, they require radical treatment in addition to the above measures. The rigid-flat foot must be rendered flexible by manipulation followed by fixation for an appropriate time and subsequently massage, passive motion, etc. The short tendons must be lengthened and traumatic conditions treated as indicated. Radical measures should be employed with ultimate discretion. Often operative interference will add rigidity to the foot and make the desired flexibility of the foot impossible when muscle power and tone have been restored. After flat-foot and associated symptoms have been relieved or cured the patient must be taught a mode of life that will prevent a recurrence of the trouble.

A condemnation of foot plates, as used in countless instances, cannot be too strong. It is important to emphasize the dangers incident to the use of ready-made arch supporters which unscrupulous shoe dealers and brace makers urge upon the customer, not because he has the wisdom to advise treatment, but because the traffic is profitable. Alluring statements relative to the causes of "painful feet," "weak ankles," "broken arches," "fallen arches," etc., infest the advertising columns of nearly every publication and erroneous claims are made of the magic cures made possible by the use of designated devices. Still more infamously do many of the shoe dealers, brace makers, and department store clerks make a diagnosis of "broken arches" and graphically picture to the patient some fatal termination if the contrivance is not used, thus inveigling the patient into almost certain loss and injury. The ignorant and reckless use of arch

supporters in the treatment of conditions due to defective muscles is unscientific and subjects the trusting public to fraud. The practice of giving careless advice—"get a pair of arch supporters"—when employed by physicians is an act to be lamented! It is difficult to believe that persons of normal intelligence can be decoyed into the notion that the pernicious devices have some property or magic by which the many ailments of the foot can be instantaneously and permanently cured, and yet the public is being constantly, not only defrauded of money, but its individuals are also the victims of malpractice. The physician who uses, temporarily, a proper plantar support, is often criticized and condemned by persons who have been cheated and deceived in the hands of an apparently learned salesman totally ignorant of the conditions and requirements of the case. Patients are constantly appearing for treatment who for years have worn flat-foot plates, still suffering from the disability and unable to discard the supports, although in the beginning of their use more or less of comfort was derived. The use of rigid arch supports, over a period of several months, although they relieve for a time distressing symptoms, weakens the muscles of the leg as well as of the foot and tends to make the patient a slave to its use. In the majority of cases such temporary employment of arch supporters is unnecessary if static errors are cor-

rected and methods to restore muscular tone and normal poise are instituted. If the surgeon's aim is to strengthen the weakened structures, he is justified in employing some temporary support to relieve symptoms if that temporizing be a matter of days only. In the same manner as a splint is discarded after the fracture is repaired so should the use of a plantar support be terminated when it has served its purpose. In case of fracture the essential treatment is fixation and rest of the part. The ideal treatment of painful flat-foot (in cases in which every step gives agonizing pain and constant standing is distressing) consists of rest of the feet and the application of appropriate treatment. Unfortunately, this cannot always be done, since in cases in which the malady is due to occupations that require foot strain, the victims must find relief that will enable them to pursue their work.

Flat foot may result from any one or more of a multitude of causes. The predisposing and causative factors should be learned, the mechanism of the development of the condition and the pathology should be ascertained and a knowledge of the habits of the patient should be acquired. With the essential data in mind, the physician should employ constitutional and local treatment suited to his case and teach his patient the cardinal laws of prevention if he desires to accomplish a permanent cure.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD NOVEMBER 19, 1915, WITH THE PRESIDENT, DR. CHANNING W. BARRETT, IN THE CHAIR

INDUCTION OF LABOR

DR CHARLES R REED read a paper entitled "Induction of Labor at Term. A Report of 100 Cases" (See p 294)

DISCUSSION

DR J. CLARENCE WEBSTER I was working in Europe when the Champetier de Rubes bag was introduced into practice, and was one of the first, outside of France, to employ it I very soon became convinced of its advantages, and have used it ever since as the best means of inducing labor In recent years I have preferred the American form of the bag as it is lighter in construction and cheaper

Dr Reed's paper is a plea for the induction of labor on a date fixed by the obstetrician after he has convinced himself that the fetus will be fully matured at that time, in preference to allowing Nature to take its course

Such a proposal is likely to meet with violent opposition in the medical profession, especially among those who believe that Nature is usually right and should be allowed to take its course Dr Reed must be well fortified with good arguments to prove that his procedure is more advantageous for mother and child

Induction of labor is a well recognized method of delivery and has in the past been restricted to special cases When carried out in a hospital, under expert care, it is attended with very little risk If Dr Reed means to suggest that it should supplant Nature's method in general practice and find universal employment in the profession, much harm will be done The procedure necessitates a thorough aseptic technique, some manual dexterity and continued watchfulness, such as best exist in hospital practice

Dr Reed speaks confidently of being able to determine the maturity of the child with accuracy I cannot agree with him Until we know when conception begins we cannot be certain as to this point All the data on which the determination of the maturity of the ovum is based are variable, e g, the escape of the ovum from the ovary, the length of time of its passage to the ovary relationship to coitus the meeting of spermatozoa and ovum, relationship to menstruation, the size of the

uterus or fetus, the quantity of liquor amni, quickening, etc

Dr Reed relies on Ahlfeld's measurement at term, but most obstetricians regard this as only relatively valuable, and not capable of giving absolute information as to the maturity of the fetus. Variations in the size of the full time child are so obvious as to make one skeptical as to the reliability of Ahlfeld's method With all the data at our disposal we may often be in error two weeks or more

However, as Dr Reed states, there is apparently little difference, as regards vitality, between a full-time fetus and one short of term by a week or even more Consequently, the opposition to his procedure must be considerably minimized if this standpoint is alone to be considered, because an expert obstetrician would rarely make an error of such importance, in estimating the maturity of the fetus, as to greatly lessen the chance of its survival

I have long held that premature labor is advisable in cases in which the obstetrician is convinced, from a consideration of all available data, that pregnancy is continuing longer than the average, particularly where the fetus is large Induction of labor in such cases probably reduces the risk both to mother and child

Dr Reed has called attention to one great advantage of labor induced by the bag — the shortening of the first stage

In the great majority of cases when the pains begin they continue to recur with shortening intervals until dilatation is completed Occasionally, they may be weak, irregular and extend over a long period of time but this variety is much rarer than among cases of spontaneous normal labor

In the Presbyterial Hospital it has been customary to introduce the bag in the forenoon In the majority of cases labor has not been completed until after midnight Very few have terminated within six hours, but a considerable number between six and twelve hours

Occasionally pains are started and cease entirely. The addition of a weight to the bag is an additional stimulus to the uterus but as a rule it is safer not to use it Cases in which labor is induced must be watched carefully, because occasionally malpositions and malpresentations may be brought about They should be discovered by the time the cervix

is well-dilated so that they may be properly dealt with.

My technique is the same as that of Dr. Reed only in cases in which I cannot dilate the cervix sufficiently for the introduction of the bag with my fingers. Ordinarily, I administer the nitrous-oxide oxygen mixture for a few minutes while my glove-covered hand is introduced into the vagina. Dilatation of the cervix is usually easily effected with the fingers and the rolled bag is passed along the palm and introduced into the cervix with the fingers.

I consider a rigid cervix as unfit for induction of labor by the bag. It is apt to be unsuccessful. Such a condition is far more suitable to the employment of vaginal or, sometimes, abdominal cesarean section. Dilatation of the cervix with metal dilators may cause laceration which may be increased with the progress of labor.

Dr. WALTER S. BARNES. I have been doing this work for about fifteen years, and in the labors that I have induced during that time I have had no trouble from infection. I have lost no mothers. I cannot give you as accurate reports as Dr. Reed has given you of these cases, but my results have been very much the same. The labors have been a little longer. I introduced into the cervix, after it had been tested out and measured as to capacity, two Barnes bags of large size, which were used in connection with a band syringe.

As regards the vulsellum testing the cervix, I have not used enough force to pull the instrument out through the cervix. As regards rupturing the membranes, it has been the exception. The shape of the bag is such that it allows free exit of any discharge, and there is no chance for the secretions to be pent up. In this respect the Barnes bag has an advantage over the Voorhees bag. The results have been uniformly good.

As to occiput-posterior positions, I have been able to correct these in many cases by introducing my hand into the uterus after placing the patient under complete surgical anesthesia. If the head fails to rotate with the methods of posture, etc., I push up on the caput place my hand in the uterus, taking the ear as a guide, apply the other hand to the shoulder and turn to the long axis of the uterus, which is safer than version of the head. I allow the head to come down. If it does not, I introduce forceps and pull it down. Labor will then soon be terminated. I save the patient from extensive damage which we see so often following occiput-posterior presentations with laceration of the perineum.

I think we will all come to see the time when this procedure will be adopted more frequently than it is at present.

Dr. CHARLES E. PADDOCK. I hardly know what to say in regard to the strong position taken by the essayist. His treatment of women, at term, is certainly a bold one and in the hands of others less skilled would seem like meddling obstetrics. It

is so at variance with the teaching of the past generation, and is not sanctioned, as far as I know, by any of the modern textbooks; it brushes aside the attitude taken to "let Nature take her course" as far as possible. Of course, we are progressing, and I will not say that this is not a step in the right direction, but I would be rather reluctant to attempt bringing on labor at a certain time in every case. I make a practice to advise that pregnancy be interrupted if the patient is a few days past term, but I do not insist that such advice be accepted, but when I say a patient is at term I am sure she is so and do not depend upon the measurements of the baby *in utero* to inform me. A majority of my patients are seen a few days after the first missed period and this sign, together with other signs and symptoms soon occurring enables me to say just where this woman is in her pregnancy. In ward cases, or cases seen late in pregnancy, I claim it is impossible to say definitely when the woman arrives at term. If I decide to terminate the pregnancy, my custom is to give the patient quinine and castor oil, which will in over 90 per cent of the cases induce labor. Knowing this, why then should the patient be submitted to the risks consequent upon insertion of a bag?

I cannot agree with the essayist upon the ease with which the bag is inserted, neither do I find the cervix so fully dilated that the bag can be attempted without first dilating the cervix, requiring an anesthetic, neither do I find the average patient is willing to submit to the operation. Again, I believe that a routine treatment, such as outlined, will cause displacements, prolapse of the cord, and occasionally infection. I am willing, however, to be convinced, and Dr. Reed has kindly consented to permit me to see him at his work.

Dr. RUDOLPH W. HOLMES. There can be no question that the hysterolynter is one of the most valuable adjuncts to obstetric procedures we have. I have never used it in a case I considered normal. However, it has been employed repeatedly, with signal success in pathological cases. For months this question of the induction of labor at so called term has been intimated, but I had not taken the matter seriously, for there is no more justification in such a procedure than there would be in performing any other obstetric operation without a valid indication. At the present time there is no department of medicine where unmerited censure and criticism are bandied about as in obstetrics. To apply this procedure without indication, in every patient, as a routine, is merely inviting still more opprobrium on a maligned specialty which already has more threats of malpractice than any other branch of medicine. To have a catastrophe happen following the use of the bag in a definite indication is justification in itself, but to have it follow where the reason is largely a matter of the physician's convenience will offer no justification in his conscience, or an extenuation in the minds of the laity. There has been so much heard recently of meddle

some midwifery in connection with unjustifiable caesarean sections, and the promiscuous use of forceps, that I believe it extremely ill advised to recommend this procedure as a routine.

As Dr Webster has stated, it is impossible to determine the date of maturity positively, as we have no conclusive data as to the date of fertilization. With all the data of the single coitus, date of the last period, day of perception of life, and finally of lightning, one may easily be led astray in determining the date of labor. The determination of maturity by means of the Ahlfeld and Perret methods frequently leads to fallacious deductions, as a large baby may be actually premature while a small one may be fully ripe. As we know positively that it is impossible to fix accurately the date of maturity, so, likewise, without this definite data we cannot say the child is post mature. Any deduction made one way is equally fallacious for the other. In Dr Reed's report he shows that one baby was to-advertently brought into the world at the seventh month. Not so long ago a caesarean section was done at this same period because the operator made a mistake in computing the maturity. This is not a culpable error but typifies the inexactness of our working knowledge.

The wife of a friend came to me when she thought she was about five months pregnant. The enlarged, discolored breasts contained colostrum, she imagined she felt life, she had not menstruated since a week or two before marriage. Her baby was born 13 months after her wedding. No one would think for a moment she had a pregnancy of that duration. At the time she came to me the uterus was soft and hardly perceptibly enlarged. The fact of an intense maternal instinct, a profound impulse given by married life, or a disturbance of ovarian secretion had produced in her a pseudocyesis. Similarly explained is the woman who came to me, convinced she was pregnant yet there was no uterine enlargement. The baby was born just a year after her first visit. No one would maintain that she had a pregnancy lasting a full year. You all know by act of Parliament, one of the ducal families of England continues its line uninterruptedly in spite of the fact the heir was born two years after the death of the "father."

I certainly have used the hysterocourter at least a hundred times in pathological cases. In some it is remarkable how quickly and effectively it acts. I recall a placenta previa where the bag was used, and certainly within ten minutes the bag was expelled, the child delivered by version and extraction and the placenta removed and the uterus tamponed. On the other hand, all of ten years ago, I repeatedly had to place the bag covering a period of five or six days, without avail, and finally had to secure dilatation by incisions. The bag Dr Reed shows does not secure full dilatation—it produces a little more than half dilatation.

The fact that Dr Reed had nine occipitoposterior positions is suggestive. Of course, accidents will

happen in one series which may not recur in another, but it is a logical belief that the bag had dislodged the head. Any one who argues that the bag does not dislodge the head is preaching sophistry or basing a statement on error of observation. It is true in obstetrics as in other connections that two bodies cannot occupy the same space at the same time. If abdominal palpation is invariably followed after the bag is introduced, it will invariably be found that the head is displaced. That good fortune attends us, and the head returns to its earlier position after the escape of the bag does not militate against the statement at all. It is a fact that the use of the bag offers an increased liability of a prolapse of the cord, or some other fetal member, that is present in normal unaided cases.

It is an inviting proposition to place a bag at a time convenient for the obstetrician, and know that within a reasonable time the case will terminate. But it is a specious argument that it is done because labor is so essentially a pathologic process.

In this connection I cannot see the expediency of using the bag when castor oil, aided by ten grains of quinine in those who can tolerate the drug, will bring on labor in at least 75 per cent of cases of the woman *is at or near term*. I am convinced that it is exceedingly remote that castor oil will precipitate labor in a woman far from term. If an error is made in the time of the exhibition of the drug no harm is done if it is before term. If the bag is introduced in a woman where the maturity is uncertain, or she has not reached that period, the baby will probably pay the penalty for the error. Castor oil as a means of induction of labor at term is not so spectacular as the introduction of a bag, but at least it does no harm.

DR RACHELLE S. YARROS. It is true that in the last decade we have all been taught to interfere as little as possible in our obstetrical cases, to watch carefully and let Nature do her work. This is apparently a perfectly legitimate protest against the meddling obstetrics practiced by the old midwives and doctors who were continually dilating the vagina, cervix, and giving ergot. Watchful expectancy has served a splendid purpose, and we must not underestimate its value. But with great change in surgical technique, with increased general knowledge and practice of asepsis as well as the growing custom of patients to go to the hospital for childbirth it would seem that the new ideas for relieving labor pains and reducing the duration of labor through medical or surgical methods might be considered with greater safety.

As Dr Webster already stated, the bag is not a new idea. We have all used it in appropriate cases with good results. We have all found cases where the bag could not be used and where the bag remained for many hours without the results that Dr Reed describes.

The idea of inducing labor at a given time in a perfectly normal case is decidedly a new idea. I am somewhat surprised that Dr Reed finds no

difficulty in obtaining the consent of his patients. Most patients that I know, intelligent and ignorant, would insist on waiting until Nature begins labor. The only reason for inducing labor before, if I understand Dr. Reed correctly, is simply because it is convenient for the physician. Perhaps it is a good reason, but we can hardly expect the lay public and most of the profession, to view it favorably. If, however, the introduction of the bag will actually prove from a further investigation, to reduce the duration of the first stage of labor, and if we can safely satisfy ourselves that with the greatest aseptic care we are not increasing the danger of infection to the mother, and that we are not converting a certain number of normal cases into abnormal ones, Dr. Reed's contribution will prove of great value, because we all feel that the first stage of labor in many cases is far too exhausting to the mother. For many years we have felt that this exhaustion is no doubt responsible for the still high morbidity that follows normal childbirth.

Dr. N. SPROUT HUNTER. Apparently the experience of different men with the introduction of the bag is quite variable and no one seems to have had anything near like the favorable results that Dr. Reed has had.

There are two or three points brought up in the discussion and also mentioned by Dr. Reed to which I desire to refer. First, the incidence of occipito-posterior presentation, whether nine cases in a hundred are an abnormal percentage. I think if we have only nine cases in a hundred it is not very large. It is in fact unusually small.

Any safe means of shortening the first stage of labor is certainly desirable. One thing that we must all remember in Dr. Reed's technique is that in every case that is not having good strong labor pains at the end of an hour a weight is attached to the bag. That is not the usual technique. Very few put on any weight except in cases of placenta previa when only enough weight is added to stop hemorrhage. Lately I have been using traction in a larger number of cases. Instead of a weight and pulley, I attach a piece of rubber tubing from the bag to the foot of the bed by means of artery forceps. By the use of an ordinary baby scales one can regulate the amount of traction.

I wish Dr. Reed's cases had not been so varied. These are consecutive cases. I wish he had taken for our instruction a hundred consecutive cases of normal pregnancy at term throwing out all unusual conditions, such as the occipito-posterior and breech presentations, nephritis, small pelvis, etc. We could then be much better able to judge as to the real merits of the bag.

Were those transverse cases you had primary or secondary to the bag?

Dr. REED. Primary.

Dr. FRANK CARY. In the last few years, since the introduction of "twilight sleep," the use of gas-
anesthesia and now this method of delivering patients I am glad I am alive at this time. [Laugh-

ter] I am a little inclined to let my patients at least go into labor before I undertake to do something. My reason for doing this in the few years I have been connected with hospitals is that I have seen some very good men induce labors on account of the tremendous size of the child, which were not so very large. I have not been able to make out when labor should begin. I find it difficult to tell when the patient is at full term, and until I can do that I shall hardly be inclined to resort to artificial means of delivering my patient until she at least begins labor.

As regards the use of the bag, I did not hear all Dr. Reed had to say, but I favor the use of the bag where it is indicated. Obstetricians differ as to where it is indicated. The rapidity with which labor can be terminated I do not think so much depends upon the use of the bag or upon the obstetrician as it does upon the wishes of the patient that the doctor is operating on. Some of these cases will resist the bag for hours, as any one knows who has undertaken to use it. My first work with Jaggard was done years ago when the bag was used in most cases of eclampsia, and on account of that condition it was necessary to deliver these patients rapidly.

I am certainly interested in what I have heard about the use of the bag. I may not see the force of using it because I have not been delivering patients according to schedule time.

I am very sorry I did not hear the paper, but I do believe in the use of the bag under certain conditions, and perhaps after I read the whole paper I may be inclined to induce labor that way, but at present I am inclined to wait a little.

Dr. ROBERT T. GILLMORE. For the past year I have observed Dr. Reed's Wesley service with profit and interest and must confess that his method has enabled me to bring on labor with less apprehension than I previously possessed.

About three years ago I induced labor prematurely on a patient at Wesley Hospital for a bad albumina. Owing to the fact that I did not apply traction to the bag as Dr. Reed now recommends, I was obliged to introduce two bags.

Last August I induced labor again for the same reason. About ten o'clock in the morning I introduced a bag applied weight to it, and at five in the afternoon delivered her of living twins without complication. The obstetrical procedure was done under twilight sleep produced by scopolamine, which I have used with more or less satisfaction for the past eight years.

In conclusion I wish to state that I have not had the difficulty in introducing the bag that a number of obstetricians have reported. In only one or two cases has it been necessary for me to use my fingers in dilating the cervix. The bag slipped in without traumatism or the use of force, and in the future it is my intention to resort to this method in hospital practice more frequently than I have done in the past.

Crile has demonstrated the effects of exhaustion in the cerebrum and in my judgment Dr. Reed is justified in his statement that the use of the bag decreases mental and physical exhaustion and is an important factor in the prevention of sepsis.

DR. CAREY CLARKE. I regard Dr. Reed's paper as an interesting contribution to our advancement in the management of labor.

As Dr. Webster has said, we have used the bag in the induction of labor at the Presbyterian Hospital after the patient has gone to what we call full time, in uncomplicated cases, for many years with results that have been satisfactory. All of them were not perfect, as not all spontaneous labors are perfect. For some months I have used the method here outlined by Dr. Reed in my private and clinical cases arbitrarily at what we call term. I think that all obstetricians will agree that it does not make much difference whether a baby is born, so far as its condition goes, on the 25th or the 26th day. When they are born at this time, spontaneously, we say the patient is at term. Therefore, I do not see any great objection to inducing labor any time during this period, from the two hundred and eightieth day on. I have been inducing labor in this way, choosing the day when the patient expresses the desire to have her baby, and I see no reason why we should not be arbitrary in that matter. I have not had as many cases as Dr. Reed reports, but I am satisfied, as he states, that the first stage of labor is materially shortened and the entire labor is shortened from four to eight hours. The second stage, of course, is not materially altered, but the first stage is definitely shortened. As a rule, we put the bag in in the morning, as early as possible, and the baby is born by supper-time or at bed time. In my last case the bag was put in at nine o'clock in the morning and the baby was born at half past two in the afternoon, the patient's third child.

As far as displacement of the head goes in the introduction of the bag, in a multipara that is relatively unimportant, because in the average multipara the head is not in the pelvis. In the primipara where the head is in the pelvis before labor it has become molded. It may be displaced by the bag but it comes down again as soon as the bag is expelled from the cervix. I have had prolapse of the hand following the introduction of the bag, but not a prolapse of the cord. So far as occiputoposterior positions are concerned, if the head comes down in that position I assume that there is more room for it posteriorly than anteriorly. Its management is not such a difficult procedure, and I see no reason why expert obstetricians should be afraid of occiputoposterior positions. These usually require low forceps extraction, though a certain proportion terminate spontaneously. As a rule, I find that the head returns to the pelvis, as soon as the bag is expelled from the cervix into the vagina. While rubber bag induction may cause displacement of the head I fail to see how it would prevent anterior

rotation since rotation occurs when the head is low, that is, after expulsion of the bag. Occasionally there is a case where labor does not ensue after the introduction of the bag, there are occasional cases where labor cannot be induced by any artificial means, and the patient must be dealt with surgically. But that does not happen very often. Once in 12 or 15 times is the impression I have now of the proportion of cases in which the bag does not induce labor. Where an effort is made to induce labor prematurely, on account of toxæmia, the pre-eclamptic condition, or something of that sort, occasionally labor will not be induced. I have seen two cases of the so called pre-eclamptic condition where labor did not ensue from the introduction of the bag.

I use a larger bag than Dr. Reed has shown and I have never found it necessary to put the bag in two or three, or four or five times as Dr. Holmes suggested. I should not reintroduce it one day after the other if it were ineffectual. I would let two or three days intervene between the efforts at induction. Indeed, if the patient has not come into labor, the bag should be removed in 24 or 30 hours. I do not find it necessary to employ traction as a rule. Where I do, I use an elastic tube, as Dr. Heaney suggested, which I first saw used in Vienna in 1903. It is important not to make too much traction, not to keep the bag too tight in the cervix. Enough to keep the tube taut is all that is required.

Labor pains come on at once with the introduction of the bag in some cases, and in nearly all there are definite regular, rhythmical contractions within one or two hours. The pains are more frequent and more prolonged than in a spontaneous first stage. In this way dilatation and effacement are brought about more rapidly and the first stage definitely shortened. Nitrous oxide analgesia controls the suffering when it becomes as severe as the terminal pains of the first stage in spontaneous labor.

DR. MARK T. GOLDSTEIN. I have had the opportunity to watch Dr. Reed's work closely and have been much interested in it and can vouch for the results he has stated in his paper. The technique has been worked out carefully and not only that, he has trained his assistants in the management of the bag so that if Dr. Reed is called away, after the bag is introduced, the case is under the close observation of a person who is skilled in managing these cases.

I think the impression is that the technique of the introduction of the bag is simple. I have just the opposite impression. I do not think that the management of the case, after the bag is introduced, is as simple as one would be inclined to believe from what has been said here tonight.

Dr. Reed's cases have been free from fever and sepsis. I attribute that as much to a lack of vaginal manipulation as I do to his short labor. In the great majority of cases the only intervaginal manipulation would be done with the introduction of the bag and after that no other examinations

made, and that has some bearing on his lack of morbidity.

I think the work as it is being carried on will impress a great many men with the results, and as Dr. Heaney stated, I would like to see the results from this method in a series of normal cases.

Dr. REED (closing). I have been much gratified at the interest that the members of the society and visitors have shown in this paper. It has been, as you can readily understand, a matter of extreme fascination to me to carry out this study. The work as it has gone on from day to day has really made life worth living in a city that is not calculated to stimulate the imagination or the soul.

In regard to the remarks made by Dr. Webster and Dr. Culbertson, I will say that both cover the subject very definitely, it makes little or no difference to babe or mother whether or not the woman is delivered two weeks before the expected time, but it does make a difference if she is delivered two weeks after her expected time both to babe and mother. I would like to emphasize that point because the baby grows with each succeeding week in pregnancy and labor becomes increasingly difficult. Dr. von Winckel has demonstrated thoroughly and completely that point, and I refer you to his paper published in the *Deutsche Klinik* for 1904, for an elaboration of the subject.

I agree with Dr. Webster as to the difficulties we encounter from a rigid cervix. I think I would rather encounter a contracted pelvis any time than these abominable, contagious, fibroid conditions of the cervix, which make the life of the obstetrician so atrociously unpleasant.

Dr. Paddock made use of the term "meddlesome obstetrics." I had expected something like that. I used to bear the term applied to surgery—meddle some surgery—when somebody opened an appendiceal abscess. I remember it distinctly. The fact of the matter is are we going to allow midwives to attend to these cases or are we going to control the process from beginning to end ourselves? That is the point. Shall we control labor, or shall we shirk responsibility? I do not mean that this is a method that the general practitioner is going to adopt universally, not at all, but for us who are engaged in this special line of work, let us as men take the responsibility for it ourselves. Dr. Paddock remarked that he could not get his patients to consent to it. I wish you could see our patients at Wesley Hospital. As the patients come back into the ward day after day with the introduction of the bag and the termination of labor in three, four, and five hours relieved of their burden, the waiting women crowd up with, Doctor, when can I have mine? When are you going to take me? Why cannot I come tomorrow? Every day we hear such expressions. There is no difficulty if you have control of your patient. I say to my people, "I can shorten labor from four to eight hours. Do you want to do it or shall you let Nature do it?" We do not insist on it. It is a matter for the mothers

themselves to choose unless the ward is full. Then we ask them to take the bag or go out and come back.

As to the introduction of the bag, Dr. Paddock and others have manifested a reluctance to do it without an anæsthetic. I would like to say, that my associates at the Wesley Hospital see one bag introduced, and after that they do it themselves without any trouble. My interns will put in the bag without giving the woman an anæsthetic, without any difficulty whatever. Is not that true, Dr. Long?

Dr. LONG: Yes, sir.

Dr. REED: They introduce the bag without any trouble whatever, month after month, and there is no difficulty connected with the technique. It is a matter that anybody can learn providing he has the mechanical or manual dexterity which enables him to do obstetrics at all and do it right. I have no trouble. The boys at the hospital who are attending this service have put the bag in at nine o'clock, and the woman is delivered at three and at six in the afternoon. Of course, I do not believe in the long duration of these cases. I do not believe in the prolongation of bag retention, and yet when I think of the old methods that we employed in pathologic cases some years ago, such antiquated and timorous technique for instance as the use of iodoform gauze, which bared with it all the evils of every half hearted measure. The gauze stuffed up into the cervix merely starts absorption at once and when it is left there for twenty four or thirty-six hours the danger can be imagined, or considering the introduction of the rectal tube which is left forty and fifty hours in the old days. It seems to me that the introduction of the bag which stays only for eight hours in the great majority of cases is pretty good obstetrics in the light of these archaic methods which are still advocated by men who should know better.

As to the use of castor oil and quinine, in many cases it is doubtless a valuable method. If the woman can be delivered with quinine and castor oil, let her be so delivered. The thing is to deliver her at the time we say and make the delivery as painless as possible. That is what we are trying to do. In the olden times frankly this method could not have been used, it would have been impossible. Why? Because in those days when the bag came out the pains sometimes stopped, labor did not go on, and this happens now sometimes. But today we have pituitrin, and it follows in afterward and the labor proceeds and the woman is delivered. The babies do not suffer and the women do not suffer for more than a few hours. We do not intend to secure complete dilatation with the bag, we merely induce labor, and Nature produces complete dilatation and does it quickly after the bag comes out. We have used a No. 5 bag which brings us complete dilatation, but it induces such violent contractions that it is not wise in my opinion to use it unless required.

The technique of the weight is also very important. The weight must be adjusted, and I am free to say that these cases do require an unusual amount of attention but if you start the case in the morning when you are fresh and vigorous, and the case terminates in the afternoon, you have spent all the time on that case that you had to, and it is much pleasanter than spending all night and all day, as we used to do waiting for the activities of a wholly indifferent Nature.

I believe what I have said covers all the points, and I thank you gentlemen for your generous discussion.

NITROUS OXIDE ANALGESIA IN LABOR, A STUDY OF 100 CASES

DR W. G. DAWORTH (by invitation) read a paper entitled "Nitrous Oxide Analgesia in Labor, A Study of One Hundred Cases" (See p. 354.)

DISCUSSION

DR CARL HENRY DAVIS: The use of nitrous oxide and oxygen in the obstetrical work at the Presbyterian Hospital began about eleven years ago. Dr Webster first used the nitrous oxide-oxygen anaesthesia in operative obstetrics when ether and chloroform were contra-indicated. Its use was gradually extended to all types of cases, but prior to 1913 it was restricted to private patients and in no case was it used longer than two hours. During the winter of 1913 Drs Lynch and Heaney experimented with the nitrous oxide oxygen analgesia using it during the entire painful stage of labor in quite a number of cases. The various members of the staff experimented with the method during the winter of 1914, and after we were all convinced that it is safe, practical, and not too expensive, Dr Webster reported the results to the Chicago Gynecological Society.

During the past seven months the technique employed has been practically the same: the post-partum care of the patient's has varied very little, and the infants have been on the four hour nursing intervals. For these reasons it has seemed best to study only the cases delivered during this period. In September, I tabulated 104 cases delivered during the previous four and one-half months. The analgesia was administered to all patients who requested it provided they could pay its cost, and to a few charity cases whose physical condition made an easy labor necessary. There were in this series 44 primiparae and 15 multiparae who had the nitrous oxide oxygen analgesia, and 18 primiparae and 27 multiparae who had nothing, or ether for delivery. Since making this study 53 more cases have been discharged from the maternity department and 50 of these had nitrous oxide and oxygen during a part or all of the painful stage of labor: the periods ranging from fifteen minutes to seven hours. There were in this second group 23 primiparae and

27 multiparae. The following table shows the comparative findings of the two studies, and is of considerable interest in that the first were more or less selected while the second group of analgesia cases were consecutive.

The statistics recorded in this table speak for themselves and while I must confess that the results are more favorable than any of us had expected, they substantiate all of the claims made for the nitrous oxide oxygen analgesia, and I believe that within the year these results will be confirmed by obstetricians in all parts of the country.

In administering the nitrous oxide-oxygen analgesia there are several points which deserve special attention. It must be remembered that nitrous oxide anaesthesia cannot be given according to other standards or rules, and furthermore, that nitrous oxide-oxygen analgesia differs from both. In administering the obstetrical analgesia the patient will never become cyanotic since this can only follow anaesthesia and is the first symptom of asphyxiation. With our present technique there is little chance of anaesthetizing the patient since we determine the minimum number of regular deep inhalations required to produce analgesia and when these are given the valve is closed and the edge of the inhaler is raised sufficiently to permit the breathing of air. As the contractions increase in duration and severity one or more inhalations is added but it is rarely necessary to continue the gas to the end of the contraction. In case the uterus is very irritable and the contractions come on so quickly that the patient feels severe pain before the analgesia can be secured it may be necessary to administer a continuous analgesia, but again there is no danger of anaesthesia or cyanosis if fifteen or 20 per cent of oxygen is added. In a case that Dr Webster confined recently, using the usual technique we were unable to relieve the suffering, but this was overcome by administering a continuous analgesia for nearly three hours. Thus far I have not had a case in which it was not possible to relieve the suffering of labor by means of the nitrous oxide oxygen analgesia, and I have used it in all types of cases and all classes of patients. Patients who refused to take anything have been forced to take the gas as a means of securing quiet in the maternity, patients who understand no English or German have been taught to take the analgesia with very little difficulty, and within a few contractions.

The administration of the nitrous oxide-oxygen analgesia, or in fact that of any form of analgesia has required a constant attendance on the patient which is very tiresome and at times quite difficult. The self-administration of chloroform *a la reine* has long been practiced in certain parts of Europe, and it has seemed that a similar method might be practical with the nitrous oxide. After several conferences with the engineering department of the A. C. Clark Co., they have perfected a release valve which is attached near the inhaler by means of

Statistics from the clinic of Dr. J. Clarence Webster, Presbyterian Hospital, Chicago.

	Nitrous Oxide Oxygen		Analgesia		No Analgesia	
	Series I		Series II—Consecutive Cases		Series I	
	44 Prim	15 Mult	23 Prim	17 Mult	18 Prim	17 Mult
Average during labor	13 5 hours	7 33 hours	11 15 hours	6 hours	17 9 hours	10 hours
Sex of Infant	11 male 11 female	7 male 8 female	11 male 11 female	11 male 11 female	11 male 11 female	11 male 11 female
Average weight at birth	7 pounds 3 ounces	7 pounds 12 ounces	7 pounds 6 ounces	7 pounds 5 ounces	7 pounds	7 pounds 1 ounce
Average loss in weight after birth first week	7 8 ounces	9 4 ounces	8 ounces	8 63 ounces	7 9 ounces	8 4 ounces
Percentage of weight lost in first week	6 2	7 53	6 8	7 15	7 14	7 37
Vorbrech bag	0	0	1	4	0	0
Pituitrin before delivery	4	1	3	1	1	1
Forceps delivery	1 L O P 1 R O P	1 uterine strenuous	1 uterine anesthesia 1 no progress 3 hours	1 high R O P 1 deep R O T	1 L O A maternal exhaustion	0
Lacerations						
First degree	13	1	7	1	7	5
Second degree	1	4	0	4	7	2
Third degree	0	0	0	0	0	0
Episiotomies	1	0	3	0	0	0
Maternal deaths	0	0	0	0	0	0
Still births	0	0	1*	0	0	0
Died first week	0	0	1†	0	1‡	1
Post partum hemorrhage	0	0	0	0	0	1
Failure to secrete milk	0	0	0	0	0	0
Days in hospital after delivery	10 8	11 9	11 7	10 7	11 1	11 1

* Patient admitted to maternity 30 minutes before delivery had not felt life since labor began Had N₂O-O less than 20 minutes

† Died 12 hours after birth Necropsy showed patent foramen ovale

‡ One premature 6 1/4 months. One injury in delivery of the after-coming head in a breech presentation Necropsy showed rupture of the longitudinal sinus

§ Case of hydramnios with premature delivery at 6 months

which it is practical for the patient to administer her own analgesia during the greater part if not all of the painful stage of labor. This valve serves a double purpose in that it prevents the mixture of air with the gas in the tube during the intervals between pains. In using the self-administration I would suggest that the mixture contain about 6 per cent oxygen, and that the mixing valve need not be changed except in case a different percentage of oxygen is desired. Should the patient not follow instructions and take more than the required number of inhalations she can do no real harm since if she should become anesthetized her fingers would relax, the inhaler fall away and the spring exhaust valve automatically close.

Nitrous oxide-oxygen analgesia in obstetrics has passed the experimental stage and is now practical in all classes of cases. In the practice of every physician who understands the science of obstetrics it is an absolutely safe and comparatively simple method of eliminating the suffering and shock of labor. When it is used the delivery room is as

quiet as any other operating room. However with the analgesia the stage of labor cannot be judged by the nature of the outcry and the obstetrician must carefully watch his patient or she may deliver her baby and not know that it is being born.

DR J. CLARENCE WEBSTER. I am glad to know that Dr. Danforth has had such interesting results. Similar results are being reported from different parts of the country.

There is one point I would like to bring to the attention of Dr. Danforth and that is, I hope he will give up the use of ether entirely for forceps delivery. I have not used ether for years, and the gas is thoroughly and absolutely satisfactory for every form of obstetric maneuver. It may be necessary to push it beyond the analgesic stage.

DR CHARLES B. REED. I congratulate the essayist and the gentlemen who are pushing gas anesthesia on the success they are achieving, and I would like to add a word of praise for the sincerity with which it is being done. It has happily been applied without the newspaper notoriety which has

unfortunately accompanied twilight sleep. There is one thing, however, which twilight sleep has done, and that is, it has compelled the profession generally to recognize the fact that woman has pain during her labor. It was in following out this idea I first took up the bag, reasoning that if a woman must have pain, why not shorten it as much as possible. Then came twilight sleep and the gas which in my opinion do not conflict. Twilight sleep we are working out as sincerely as we can at Wesley Hospital, and, as I mentioned, it is a first and second stage anæsthetic, whereas gas, as we use it, can be employed to best advantage in second stage cases. If a woman is not anesthetized previous to her second stage or comes in at the time when labor will terminate within two hours, twilight sleep would be definitely contra indicated, and the gas just as definitely indicated, and it is a desirable addition to the armamentarium of the obstetrician.

I would like to ask Dr. Davis who spoke about post partum care if in his opinion early rising of the woman does in his experience bring too much strain upon the ligaments, if the enlarged uterus, still congested from labor, does not pull too strongly upon the ligaments and possibly develop a weakness.

As regards the shortness of the labor, I would like to say in my opinion it is highly desirable to get the labor as closely and as rationally as possible down to the quickest minimum.

I congratulate both of the gentlemen on their work with the gas.

Dr. CARL DAVIS: That question was one which worried us for a long time at the Presbyterian Hospital and caused us to take up the early rising, as it were, rather carefully. Dr. Heaney was in Europe at the time and came back rather enthusiastic about it while the rest of us were skeptical. About a year and a half ago, however, I became interested in a subject which is somewhat foreign to this, but which did bring to a focus the question of early rising.

In looking up the statistics on thrombosis and embolism, I found that the general statistics in the German clinic showed one case of fatal embolism as an average in nine hundred cases, whereas in two of the clinics, where they put the patients up on the second and third day, in 500 cases there was not a single instance of thrombosis or embolism.

That was very suggestive, and so we started in using more than we had done previously the backrest on the second day, still keeping the patients in bed longer than a period of eight to ten days. Then we studied the situation from another angle and decided it was easier for the patient to sit in a chair beside the bed than to sit in a rather uncomfortable position with the makeshift of a back rest, and so our patients are not allowed to walk, but are helped into a chair and sit on a pillow at the side of the bed. That gives drainage. It does not cause any extra strain on the ligaments, and thus far we have not seen a case in which there has been any harmful results occur from this procedure, and at the end of ten or eleven days a rectal examination is made before the patient leaves the hospital which shows that the uterus is down about to the point we expect at the end of two weeks. This gives us better drainage, and I do believe it is a real advantage.

Dr. DANTFORTH (closing): I was much interested in seeing Dr. Davis' table of results following analgesia, it corresponds with those who have been accustomed to using this method since we started the use of analgesia.

This little apparatus with a small valve for the self administration of the gas I have not seen before. I knew it had been brought out. It appeals to me as being an excellent device. I shall certainly try it, and hope later to have some experience along that line to report.

I have been frequently asked by those who are not accustomed to using gas as to the cost of gas analgesia. I referred in my paper to the fact that one small tank would suffice for a number of hours. We find as a routine, taking all cases as they come, ward cases and all, the expense is between two and three dollars per hour, so that making a charge at that figure you can pay all expenses connected with the administration of the gas, such as the buying of the gas, and the salary of some one to give it. If the head nurse of the obstetrical department could be trained to give it efficiently and constantly, the gas could be given for less than that.

Since the presentation of a paper by Dr. Heaney on this subject, I have had occasion to give the gas during the manual rotation of an occipitoposterior without any complaint of pain on part of the patient.

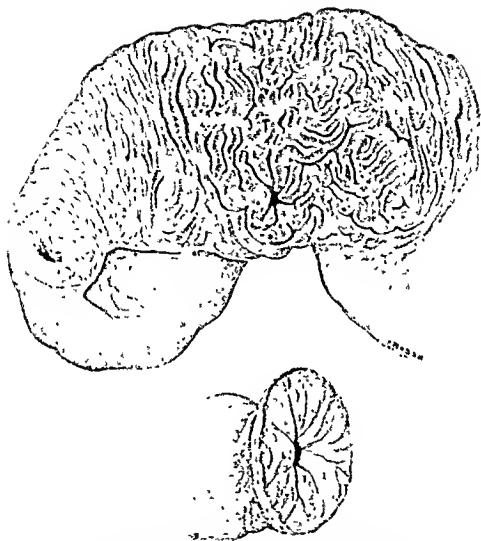


Fig 6 (above) Stomach of Dog 246, 87 days after Biondi operation
 Fig 8 Resected pylorus (patient B C) Stitch still in place 20
 months after pyloric exclusion Pylorus patent
 (Richard Leussink)

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PYLORIC EXCLUSION

AN EXPERIMENTAL AND CLINICAL STUDY¹

By RICHARD LEWISOHN, M.D., NEW YORK CITY

UNTIL a few years ago gastro enterostomy was generally considered the method of choice for the treatment of pyloric and duodenal ulcers. It was considered unnecessary to add anything to this procedure. Even in the recent literature we find papers advocating this operation for ulcers of the stomach and duodenum. Pater-son for instance, read a paper before the Clinical Congress of Surgeons, in Chicago, two years ago, in which he stated that "the occlusion of the pylorus is an unnecessary complication of gastrojejunostomy and is based on erroneous pathology."

This opinion, however is rather an isolated one. In fact most surgeons agree that a simple gastrojejunostomy will not permanently cure the disease. Those who advocated simple gastro enterostomy for the cure of pyloric and duodenal ulcers, assumed that all the food with the gastric juices would pass directly through the anastomosis between stomach and jejunum, and no longer through the pylorus and duodenum.

Kelling however, proved conclusively about fifteen years ago the fallacy of this idea. He established a gastrojejunostomy and a duodenal fistula in dogs, and observed that most of the stomach contents were discharged through the duodenal fistula and that only a small amount of food passed through the anastomosis into the intestines. It is thus

clear that a simple gastro enterostomy will not prevent the food from passing over the ulcerated area. To be sure, the regurgitation of bile through the anastomosis probably plays a certain curative rôle, by counteracting the hyperacidity of the stomach contents. This alkalization alone, however, does not suffice to cure ulcers permanently.

Furthermore, it is a well-known fact that without simultaneous resection or occlusion of the pylorus a simple gastro enterostomy is apt to contract in a very short time. Thus all the food will again pass through the pylorus and conditions which existed before the operation, will be re-established.

The vast majority of surgeons, therefore, agree that pyloric exclusion ought to be added to gastrojejunostomy to insure the permanent cure of pyloric and duodenal ulcers. This consensus of opinion, however, holds good only for the principle of pyloric exclusion. There still exists a great difference of opinion as to the best method of accomplishing this and in consequence many different methods are in use at the present day.

The different methods of pyloric exclusion can be divided into five groups:

- 1 Unilateral pyloric exclusion (Liselsberg)
- 2 Submucous plastic (Guird)
- 3 Infolding method (Kelling Mayo)
- 4 Exclusion method with the aid of auto plastic material (Wilms)

¹From the Department for Surgical Research, College of Physicians and Surgeons, Columbia University and the Surgical Service of the Montefiore Home, New York City.

5. Exclusion methods with the aid of foreign material (suture, etc.) (Kelling Berg Cackovic Parlayecchio Biondi)

The unilateral pyloric exclusion (Fig. 1A) has quite a unique position among all these different methods. For it is universally conceded that Lischberg's method provides for a permanent occlusion of the pylorus. An exceptional case, as the most interesting case of Gerster, reported by Moschcowitz, does not depreciate the value of this method. However, all the other methods of excluding the pylorus, though heralded by their originators as permanent occlusion methods, have not been able to stand the experimental and clinical tests of other investigators, in so far as the question of permanent occlusion of the pylorus is concerned. Yet Lischberg's method is used and justly, only by a comparatively small number of surgeons. For this method is a much more formidable surgical procedure than any of the other methods. And though its absolute ultimate success must be granted, the comparatively great operative risk stands in the way of its general use for the treatment of pyloric and duodenal ulcer.

Curat's method is a reverse Heinecke-Mikulicz pyloroplasty applied to the sero-muscularis, but leaving the mucosa intact. A transverse incision is made on the anterior surface of the prepyloric part of the stomach and the walls of the incision united in the longitudinal direction, thus producing a fold of the mucosa which obstructs the lumen of the pylorus. This method does not seem to have gained popularity, probably because the stitch and bind methods obtain the same object in a much more simple way.

The infolding stitch method (Kelling Mayo) is shown in Fig. 1B and the very simple technique does not require any further explanation. Lippenger who tested the different methods of pyloric exclusion in a series of animal experiments, showed that this method does not yield any permanent results. Furthermore, Moschcowitz and Wdewsky have lately reported a case in which they had occasion to test the permeability of the pylorus two weeks after the performance of a gastro-enterostomy combined with the Mayo exclusion. The patient had to be re-operated

upon because of intestinal obstruction. The post mortem examination showed the pylorus to be patent "no complete closure of the lumen of the pylorus had been obtained."

Wilms' method of pyloric exclusion (Fig. 1C) makes use of a free transplant of fascia (usually taken from the fascia lata) which is used as a constricting band around the pylorus. Kolb, an assistant of Wilms, has reported that this method has stood the test of animal experiments and clinical experience, especially in reference to the permanency of the exclusion. Biggio, however, found that the transplanted fascia was microscopically and microscopically partly absorbed and necrotic and the result by no means ideal.

I wish to discuss more in detail the last group, i.e. exclusion with the aid of sutures, wires, cotton tape, etc., because the experimental work which I am going to describe in this paper falls under this heading. Three different methods belong to this group: Kelling Berg Cackovic Parlayecchio Biondi. Though the methods fall in one group in that foreign material is used in all of them for the constriction of the pylorus, the technique differs widely.

Exclusion of the pylorus with the aid of a ligature (Fig. 1D) is not a new procedure. It was used by Kelling in animal surgery in 1899, and introduced into clinical surgery simultaneously and independently by Berg and Cackovic in 1903. A double Pagenstecher linen suture armed with a needle is carried around the posterior stomach wall and is held in place by taking several bites in the anterior wall of the stomach. The suture is then tied and the pylorus thus occluded, the knot is buried by a few single stitches (Berg). This exclusion stitch has acquired great popularity in the treatment of acute and chronic ulcers of the pylorus and duodenum.

Parlayecchio's method cannot be considered as a new one but simply represents a slight modification of the method just described, in that he substituted a cotton tape for the Pagenstecher stitch. Randisi and Dominici have published excellent results with this method. Lariche, however, has reported that his results with this method were by no means satisfactory.

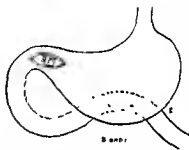
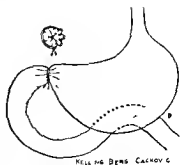
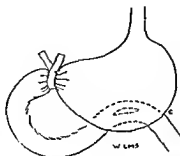
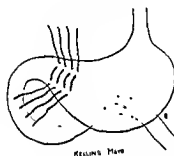
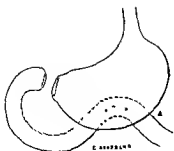


Fig 1A Von Eiselsberg method of pyloric exclusion
 Fig 1B Kelling Mayo method of pyloric exclusion
 Fig 1C Wilms method of pyloric exclusion

Fig 1D Kelling Berg Cackovic method of pyloric exclusion
 Fig 1E Biondi method of pyloric exclusion

Biondi's method (Fig 1E) was described in detail by Porta. A longitudinal incision is made across the pylorus through the serosa and muscularis, and the musculo-serosal coat peeled away from the mucosa. The mucosa is then cut between two ligatures which have been tied around the tube of the mucosa at both ends of the incision. The stumps are carbolyzed and the seromuscularis incision closed with a few sutures.

The Biondi method undoubtedly stands midway between the very simple constriction methods (Mayo, Wilms, Berg, Cackovic) and Eiselsberg's unilateral exclusion. A perusal of the literature shows that none of the simple constriction methods assures permanent results. Eiselsberg's method as already mentioned is too great a surgical procedure. Biondi's method would meet all requirements, if the technique were as easy of performance as the constriction methods and as certain of permanency as the method of Eiselsberg.

It is obvious though that the method as described by Biondi can not assure a permanent closure of the pylorus. The ligature around the mucosa stumps is apt to cut

through at an early date. Furthermore, the regenerative power of the mucous membrane is so forceful, that the small defect caused by the operation will heal over in a very short time, thus restoring the original state of affairs.

A permanent occlusion, however, would be assured, if instead of closing the linear incision in the seromuscularis, the stomach were to be divided and the two stumps buried in the pyloric and duodenal end respectively.

This modified method of Biondi is performed in the following manner: Gastroenterostomy. The gastrohepatic ligament is ligated in the pyloric region, which enables us to deliver the pylorus in front of the abdominal wall. The transverse incision through the seromuscularis (Fig 2) is then carried around the pylorus. The muscularis is peeled away from the mucosa which is thus exposed intact for about one inch. The mucosal tube is ligated above and below (Fig 3) with a silk or Pagenstecher ligature, cut in between the ligatures (Fig 4), and the stumps carbolyzed. Figure 5 shows the burying of the stumps on the stomach end and on the duodenal end.



Fig. 2. Modified Blum method showing exclusion of pylorus and musculature.



Fig. 3. Modified Blum method showing fixation of pylorus to posterior wall.

The experimental work was done along two lines: (1) Exclusion of the pylorus according to Blum; and (2) operations with the modified method just described.

1. *Exclusion of the pylorus (Blum).* This method was applied on five dogs. One dog which showed some signs of distemper on the day of operation died the next day. The other four dogs were observed sufficiently long time to make the post mortem findings of value. The results are the following. The exclusion was in place after fourteen days (dog 256). After twenty one and thirty four days (dogs 220 and 160) the lumen had become re-established and admitted a medium size glass rod. The findings after eighty seven days are shown in Fig. 6 (fractured). The only trace of any operative interference is the Pagenstecher stitch attached to the mucosa and protruding into the lumen of the stomach, otherwise the feel of the operation in the pyloric region appears to be perfectly normal.

Macroscopic examination (Fig. 5) (Pathological Association No. 1531). This section shows a portion of the pyloric end of the stomach and a large part of the duodenum. The mucous membrane is intact throughout except for some artefacts in the section and appears normal. The muscularis mucosa is intact throughout the length of the specimen. The submucosa appears somewhat thicker than normal and is composed of very dense fibrous tissue except for the thickening of the submucosa the section resembles a normal section of this portion of the gastro-intestinal tract.

2. *Exclusion of the pylorus (modified Escherich).* This series comprises five cases. In one case (dog 166) the result was spoiled by an error in technique. In performing vivisection the musculature from the mucosa the latter was accidentally opened at the duodenal side and the intestinal contents escaped. The dog died the following day and the post mortem ex-

amination showed a leakage of the duodenal stump. Another dog (251) died four days after the operation from an unknown cause. The operative result was perfect. Three dogs (101, 224, 155) were observed thirty eight, sixty and one hundred and fifty four days respectively. In all of them the exclusion was perfect. It is noteworthy that a permanent and absolute occlusion of the pylorus.

The advantages of the original Blum method and its modification, as compared with the Escherich method are the following. No extensive hefting is required. No clamps which take up a great deal of space are needed. The Blum method does not form large stumps and therefore makes the infolding of these stumps much easier than does Escherich's method.

The Blum method would therefore be preferable to the Escherich method if the technique were an absolutely safe one. The technique, however, is by no means as simple as Porti has claimed. The dissection of the musculature from the mucosa is not as easy as appears from his description. My records show that during this process the mucosa was accidentally injured a few times. The great risk of this accident is obvious. As no clamps are applied in the Blum method leakage of intestinal contents and infection of the peritoneum are grave dangers of this procedure. Gibson and Beckman have already drawn attention to this difficulty in Blum's technique. For the same reason Strauss' method a combination of the method of Wilms and

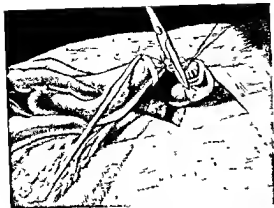


Fig 4 Modified Biondi method showing division of mucous membrane

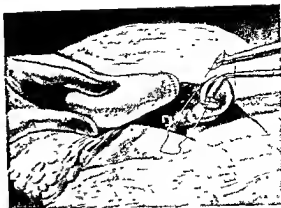


Fig 5 Modified Biondi method showing the burying of the stumps

Biondi, cannot be considered absolutely safe, though the results of his animal experiments are certainly very satisfactory.

This technical difficulty, however, would not prejudice us against this method, if it were really to assure a permanent occlusion of the pylorus. The specimen represented in Fig 6 (frontispiece) shows conclusively, however, that the original Biondi method does not guarantee a permanent occlusion. It is really remarkable to observe the regenerative power of the gastro intestinal mucosa of this specimen. Ligation of the mucous membrane in two places, division of the same between these ligatures, and carbolicization of the stumps did not leave after two months a trace of any surgical interference, except one stitch still *in situ*.

If the Biondi method, as shown from our experiments does not safeguard against reopening of the pylorus, we certainly cannot expect any permanent occlusion from the infolding and constriction methods (Mayo, Kelling, Berg, Wilms, etc.). We must agree with Leriche who came to the conclusion that with the exception of Eiselsberg's method all the different forms of pyloric exclusion are "un parodie du l'exclusion vraie." It is perfectly true that none of these methods guarantee a permanent occlusion of the pylorus.

As far as the permanent result is concerned we cannot therefore agree with the statement of Berg that his method "effectually and permanently excludes the antral end of the

stomach and duodenum from the passage of stomach contents through them."

That this statement is correct is proved by a human pylorus which I had occasion to resect a few months ago. The rarity of this specimen induces me to give the history somewhat in detail.

B. C., aged 24 years, was operated on by Dr. A. A. Berg, at the Beth David Hospital, for duodenal ulcer, in September, 1913. A gastro enterostomy was made and the pylorus was occluded by an encircling stitch. The patient was relieved from her symptoms for a few months only. Afterward her symptoms reappeared and she entered the Montefiore Home. An exploratory laparotomy was performed by Dr. Charles Goodman, May, 1914. He found the gastro enterostomy wide open and the pylorus patent. The upper part of the small intestine was studded with small grayish nodules. **Diagnosis.** Tuberculous peritonitis. After the second operation she was relieved of her symptoms for a while and then her old symptoms recurred. Radiography showed retention of food in the pyloric pouch, distal to the gastro enterostomy. Though the possibility of a gastric neurosis (hysteria) was considered, it was deemed possible that a resection of the stomach near the gastro enterostomy might relieve her symptoms.

Operation. July, 1915 (Lewisohn). Gas and ether anesthesia. Right pararectal incision, gastro enterostomy is patent. The large intestine is of normal appearance, not dilated, no nodules on its surface. The small intestine is of normal caliber. The walls are soft, no ulcers are felt. On the surface of the proximal part of the ileum a few whitish nodules are noticeable. The pylorus is patent, admitting the little finger (Fig. 9). No ulcers are palpable at the pylorus or in the duodenum. On the anterior surface of the pylorus the old Pagenstecher stitch, situated



Fig. 7. Microscopical section of pylorus taken 8 days after Blum's operation (Fig. 24). No. 4531. Path. Surg. (X325)

subperitoneally, is still in existence. Resection of the pylorus and lacer suture is both complete.

The patient was again free from vomiting for a while. Her symptoms however repeated. Evidently she is suffering from a neurosis.

The specimen of the pylorus shows the stitch on the anterior surface slightly curved, the knot is distinctly visible and intact. The mucous membrane does not seem to be atrophic on microscopic appearance. No remains of the stitch are noticeable on the posterior surface of the pylorus.

Microscopical examination of section from the anterior wall (Accession No. 4564) (Figs. 10 and 11). The wall of the pylorus (Fig. 10) appears considerably thickened at the constricted portion. The mucous membrane appears normal except for slight thinning of the constricted portion. The submucosa is much thickened, composed of dense connective tissue. The remains of the suture can be seen surrounded by an area of thickened connective tissue, round cells and giant cells. The muscularis is thickened at the point of constriction; the thickening being due to the increase in the connective tissue. Figure 11 shows very well finer details of the fate of the threads, distinctly surrounded by a ring of connective tissue, a great mass of inflammatory tissue and numerous giant cells are distinctly seen in this section. A bridge of connective tissue has

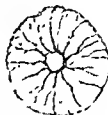


Fig. 9. View of pylorus lumen 52 months after pyloric exclusion (patient B. C.).

grown between the two parts of the double thread separating them entirely.

Microscopical examination of section from the posterior wall (Accession No. 4565) (Fig. 12 and 13). A section from the posterior wall (Fig. 12) shows the same thickening of the submucosa, but to a much less marked degree. At the point of constriction the serous coat is very much thickened by an increased amount of fibrous tissue, in which the remains of the suture are visible. The muscularis is interrupted at this point by a narrow band of fibrous tissue which runs from the submucosa to the serous coat. The mucous membrane appears entirely normal. Figure 13 shows finer details of the stitch and surrounding tissues. The findings are about the same as in Fig. 11. The mass of inflammatory tissue is larger than in the corresponding section from the anterior wall. The giant cells are not quite as numerous.

This specimen shows conclusively that the occlusion was not a permanent one. This is in accordance with radiographic findings reported from different clinics. Radiographs taken a year or more after the exclusion show a re-opening of the pylorus in a great majority of cases. Pictures taken a few months after the exclusion are of no value for it can be well conceded that all these methods provide for a temporary exclusion of the pylorus. The re-establishment of the pylorus lumen following occlusion may be explained by the following hypothesis.

The constricting stitch placed to occlude the pylorus by its pressure gradually cuts through a part or the whole of the peritoneum similarly through muscularis through submucosa and mucosa. This process continues until the stitch has cut to the point where pressure is no longer exerted upon the tissues. Repair of the divided structure proceeds immediately behind the ligature as it advances through the tissues. Thus at no time is there an opening in the intestinal wall. When the



Fig 10 Microscopic section of anterior wall of pylorus (patient B C, Surg Path No 3 664) a Exclusion stitch (X30)

ligature comes to rest it is sometimes free in the pyloric lumen, sometimes it is embedded in the wall of the pylorus, as any non absorbable suture material may be. The actual cutting process caused by the stitch takes place through degeneration, death and disintegration of the cells. The local compression of the vessels and cells deprives the tissue of nutrition causing cell degeneration and death. Autolytic ferments and phagocytic activity lead to the cell disintegration and removal. The connective-tissue stroma, as the tissues come together behind the suture, proliferates repairing the defect from the loss of cells. Cicatricial tissue therefore repairs and leads to regeneration of the intestinal wall.

I think that the arguments about the permanent anatomical exclusion of the pylorus and about the preference of one method over the other are rather futile. We can grant that with the exception of Eiselsberg's method or

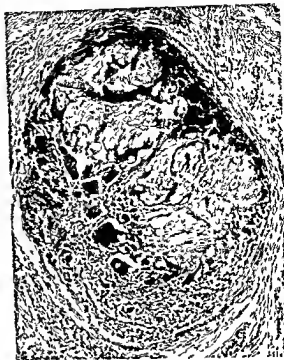


Fig 11 Same as Fig 10. Threads surrounded by a dense ring of connective tissue, round and giant cells. (X200)

the modified Biondi method above described, none of the exclusion methods will insure a permanent occlusion. The argument is really academic only. The patient consents to an operation because he wants to be relieved of his symptoms. It is immaterial to him, whether his pylorus is patent after a certain time, as long as he is permanently cured.

It is evident that all we have to do to obtain that result is to prevent food and stomach juice from coming in contact with the ulcer for a few months (or possibly for a few weeks only). A temporary absolute exclusion of the pylorus, not a permanent one, is needed. This purpose is just as well obtained by the exclusion stitch with a Pagenstecher suture which seems to be technically the most simple procedure, as by any of the other more complicated methods (Wilms, Biondi, etc.)

CONCLUSIONS

1. With the exception of Eiselsberg's unilateral exclusion and the modified Biondi method, none of the different methods of



Fig. 1. Microscopic section Surg. Path. No. 3760 of posterior wall of pylorus (patient H. C.)—a Fishberg stitch. $\times 35$.

exclusion guarantees a permanent occlusion of the pylorus.

2. An absolute though temporary exclusion of the pylorus provides for a permanent cure of pyloric and duodenal ulcers.

3. The most simple method from a technical standpoint is the exclusion stitch (Kelling-Berg-Lackov). This stitch should be used in preference to the more complicated methods (Wilms-Paritexclue-Blander).

4. The Liseberg's method and the modification of the Biondi method, though guaranteeing a permanent exclusion are technically too complicated and should not be used.

5. The clinical results are just as good in using the most simple method (exclusion stitch) as in the use of the most complicated method (Liseberg). The exclusion stitch is therefore the method of choice for the treatment of pyloric and duodenal ulcers.

REPORTS OF ANIMAL EXPERIMENTS

A. ANIMAL METHOD

Dog 345. Previous gastro-enterostomy had been done by students May 1, 1915. Dog has same

distemper. Operation, May 11, 1915. Pararectal incision, pylorus brought forward, pyloric artery tied, seromuscular coat incised and liberated from mucosa, mucosa ligated above and below (silk) and cut in between, stump cauterized and buried, layer suture of abdomen. May 12. Dog died of distemper. Post mortem examination. No peritonitis. Gastro-enterostomy patent. Exclusion stitches in place. Observation time, one day.

Dog 356. Surg. Path. No. 3407. Operation, March 23, 1915. Gastro-enterostomy posterior antecolic, gastropyloric ligament ligated and cut thus facilitating protrusion of pylorus in front of abdominal wall, pylorus cut, mucous membrane ligated in typical fashion, central ligature, cut by mistake reapplied seromuscular sutured, layer suture of abdomen. April 6. Killed on account of distemper. Post mortem examination. Peritoneum smooth, gastro-enterostomy functional, exclusion evidently holding. Observation time, fourteen days.

Dog 320. Surg. Path. No. 3485. Operation, April 27, 1915. Median laparotomy, suture gastro-enterostomy, longitudinal incision of seromuscular over pyloric region, mucosa freed all around and cut through between two ligatures, stumps covered by musculo-serous suture, abdomen closed. May 17. Died of bronchopneumonia. Post mortem examination. Gastro-enterostomy patent. Pylorus is patent again for medium sized glass rod. Observation time, twenty-one days.

Dog 366. Surg. Path. No. 3511. Operation, November 24, 1915. Typical gastro-enterostomy posterior antecolic, exclusion of pylorus, small longitudinal incision over pyloric region through serosa and muscularis, attempt to strip muscularis from mucosa very difficult as tissues are adherent to one another, therefore transverse incision made, encircling most of the stomach. December 18. Died of lobar pneumonia. Post mortem examination. No peritonitis. Specimen removed in box. Pylorus patent. Observation time, thirty-four days.

Dog 330. Surg. Path. No. 3511. Operation, March 17, 1915. Gastro-enterostomy posterior antecolic, typical pyloric exclusion according to Biondi. Exclusion technique worked very well in this case. Stumps covered with seromuscular coat. June 8. Killed. Post mortem examination. Removal of stomach, duodenum, and upper part of jejunum. Gastro-enterostomy patent. No outside scar visible in pyloric region. Omentum slightly adherent to this region. The pylorus is perfectly open exactly like a normal pylorus. Stomach opened along the lesser curvature into the duodenum. The pyloric duodenal junction is perfectly normal. One Pagenstecher stitch lying in this region is the only sign of operative interference (Fig. 6 frontopex). Observation time, eighty-seven days.

B. MODIFIED BIONDI METHOD

Dog 316. Operation, December 8, 1914. Gastro-enterostomy posterior antecolic with clamp, pylorus cut on its anterior surface through serosa

and muscularis, after freeing the pylorus from its attachment (gastrohepatic ligament). In trying to pass an aneurism needle around the mucous membrane, the latter was pierced and some stomach contents escaped. Suture of both duodenal and stomach end of the mucosa, inverting suture of both stumps, which is very unsatisfactory on the duodenal end, closure of abdominal wall. December 6. Died of peritonitis. *Post mortem examination*: Peritonitis in upper abdomen, leakage of duodenal stump. Stomach end of resection in good condition and gastro-enterostomy perfect. *Observation time*, one day.

Dog 129. *Operation*, December 13, 1914. Typical gastrojejunostomy, pylorus freed all around and brought outside of abdominal parietes, transverse section through serosa and muscularis in anterior and posterior aspect of stomach, ligature of mucous membrane above and below (Biondi), and inversion of stumps of stomach and duodenal end, closure of abdominal wall in layer sutures. December 19. Died. *Post mortem examination*: No peritonitis, exclusion in good condition, specimen lost in transit. *Observation time*, four days.

Dog 103, Surg Path No 3,261. *Operation*, December 1, 1914. Typical gastro-enterostomy posterior antecolica, a cross incision made over the pylorus on the anterior wall of the stomach, and serosa muscularis peeled back from mucosa, an aneurism needle was carried around the mucous membrane at the posterior wall and the mucous membrane ligated between two silk ligatures and cut in between, the stumps were carbolized, the rest of the seromuscularis coat was now divided and a running suture united the incision at the stomach end, thus burying the mucous membrane stump. Same procedure for duodenal end. Suture of abdominal wall. January 7, 1915. Dog died. *Post mortem examination*: Bronchopneumonia. Peritoneal cavity normal. Exclusion perfect. No local peritonitis around excluded part. Right middle lobe of lung shows extensive pneumonia. *Observation time* thirty eight days.

Dog 244. Surg Path No 3,544. *Operation*, March 16, 1915. Gastro-enterostomy posterior antecolica, longitudinal incision one inch long across pylorus cutting through serosa and muscularis, the stripping off of the muscularis from the mucosa successful only after small transverse incision had been added, pin hole opening accidentally made in mucosa, double silk ligature then carried around on aneurism needle, tied proximally and distally and mucosa cut through in between, stumps carbolized, musculoserosa incision sutured over stumps. June 15. Killed. *Post mortem examination*: Gastro-enterostomy patent. Pyloric exclusion perfect at both ends (stomach and duodenum). *Observation time* sixty days.

Dog 155, Surg Path No 3,543. January 12, 1913. Typical posterior gastro-enterostomy. Pylorus then cut across transversely after ligating gastrohepatic ligament. Cut down to mucosa.



Fig 13. Same as Fig 12. Same findings as in Fig 11. The defects in the cross section of the linen threads are artefacts caused by the microtome knife. (X200)

Muscularis stripped away from mucosa with some difficulty. Ligatures tied around mucosa sac above and below and cut in between. As both ligatures were too near each other, they slipped off. Openings closed with suture and then buried. Layer suture of abdomen. June 15. Killed. *Post mortem examination*: Gastro-enterostomy patent. Inner silk suture still in place on one spot. Occlusion of pyloric end of stomach and duodenum perfect. *Observation time*, one hundred and fifty four days.

BIBLIOGRAPHY

- BACCIO. Sull'esclusione del piloro coi metodi costruttivi. *Clin chir*, Milano, 1913, xxi, 1053.
 BERG. Einseitige Ausschaltung des Duodenum bei perforirender Geschwüersbildung an der hinteren Wand des absteigenden Duodenalastes. *Zentralbl f Chir*, 1903, xxx, 556.
 Idem. Duodenal fistula: its treatment by gastrojejunostomy and pyloric exclusion. *Ann Surg*, Phila, 1907, xlv, 721.
 Idem. The influence of gastro-enterostomy on gastric and duodenal ulcers. *J Am M Ass*, 1913, lv, 881.
 CACCIORIO. Einseitige Ausschaltung des Duodenum bei perforirender Geschwüersbildung an der hinteren Wand des absteigenden Duodenalastes. *Zentralbl f Chir*, 1903, xxx, 649.
 DOMINICI. Darmausschaltung mit dem Verfahren von Parlaecchio. *Deutsche Zeitschr f Chir*, 1912, cxviii, 399.

ISLISBERG Ueber Ausschaltung inoperabler Pylorus stricturen nebst Bemerkungen ueber die Jejunostomie Arch f klin Chir, 1895, I, 919
 ISLISBERG Zur unilatralen Pylorusausschaltung Wien klin Wchnsch, 1910, xxiii, 44
 GIBSON AND BEEKMAN Occlusion of the pylorus Ann Surg, Phila, 1915, lxi, 423
 GIRARD Zur Technik der Pylorusocclusion Arch f klin Chir, 1911, xcv, 573
 Kelling Studien zur Chirurgie des Magens Arch f klin Chir, 1900, lvi, 1
 KOLB Insaizmethoden der unilatralen Pylorusausschaltung Beitr z klin Chir, 1912, lxxviii, 1
 LERICHE Comment faut il réaliser l'exclusion du pylore et du duodenum? Lyon chir, 1913, 5, 27
 MAYO Duodenal ulcer Ann Surg Phila, 1904, xl, 1900
 MOSCOWITZ Ann Surg, Phila, 1913 lxi 942 (Discussion)

MOSCOWITZ AND WILENSKY Intestinal obstruction consecutive upon posterior retrocolic gastro-enterotomy Surg, Gynec & Obst, 1915, xxi, 300
 PARLAYECCHIO Exclusion pylorique par ruban et non par liuret Presse méd, 1911, xxi, 341
 PATTERSON The operation of gastrojejunotomy and the principles which should determine its use Surg, Gynec & Obst, 1914, xiii, 423
 PORTA Pylorusausschaltung nach Biondi Deutsche Zeitsch f Chir, 1911, cxxv, 511
 RANDISI L'exclusion del piloro col metodo del Palla vecchio Clin chir, Milano 1910 xiii 2131
 STRAUSS Two new methods of closure of the pylorus for pyloric and duodenal ulcers J Am M Ass, 1914, lxi, 1525
 TAPPEINER Zur Frage der Pylorusausschaltung Beitr z klin Chir, 1911, lxxx, 408
 TAPPEINER Zur Frage der Pylorusausschaltung Beitr z klin Chir 1914 xxi, 146

THE END-RESULTS OF FOURTEEN OPERATIONS FOR PERFORATED GASTRIC AND DUODENAL ULCERS¹

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THREE series of cases here reported were operated on by me or my associates, Doctors Hitzrot and Lee, at the New York Hospital since February 11, 1913, a little less than three years. This series does not include any cases previously reported by me in other publications. All patients surviving (13) have been carefully followed as regards their after history and end results. In 10 cases we have gastric analyses and in 12 cases X ray pictures of the stomach. The summary of their condition is shown in Table I. All the patients were males, the average age 35. The average duration of the perforation before operation was about ten hours, and to this relatively short period of time must be attributed the main factor in obtaining the 92 per cent of successful cases. The perforation was situated in the duodenum in 7 cases, in the stomach but close to the pylorus in 7 cases. Case 12 had two simultaneous perforations of the duodenum. Only three cases gave a history of freedom from previous or obvious gastric disturbances (Cases 1, 9 and 13), the others giving characteristic histories of ulcer trouble, some going back as far as fifteen years. Case

8, the fatal case, was obviously hopeless and probably an operation would not have been attempted by most surgeons. It has been our policy always to give every case, no matter how desperate a possible chance of recovery, which sometimes occurs. The symptoms dated back thirty six hours, there was a recognizable general peritonitis and operation was performed only after a saline infusion, the patient surviving only two hours.

We have been impressed with Deaver's statement that the patient improves in these cases after the peritoneum has been opened, allowing the escape of free intestinal gas. In a few cases blood pressures have been taken throughout the operation to determine whether this improvement is borne out by the rise in blood pressure. Our findings, however, are contradictory and inconclusive.

FREQUENCY IS COMPARED TO OTHER ACUTE ABDOMINAL CONDITIONS

Collinson² says, "Perforation of a gastric or duodenal ulcer is with the exception of appendicitis the most frequent acute abdominal lesion." Our experience does not verify

¹ J Am M Ass, 1914, October 3.

² Read before the Chicago Surgical Society, January - 1916. (See discussion p. 408.)

TABLE I—ACUTE PERFORATIONS OF STOMACH AND DUODENUM

No. of Case	Age	Diagnosis	History of Perforation	Time Between Admission to Hospital and Operation	Soft Stool Diet After Operation	All food up After Operation	Discharged After Operation	Gain in Weight After Operation	X-ray Findings After Operation	Gastric Analyses
1	26	Duodenal ulcer	2½ hours	1 hour	3 days	15 days	21 days	255 pounds in 1 month	Slight gastric retention—1 month	Well marked hyperacidity (1 mo. after operation)
2	32	Gastric ulcer	24 hours	50 minutes	7 days	22 days	23 days	Regained normal weight in 1½ years	No gastric retention—1½ years	Acidity approximately normal (1½ yrs. after operation)
3	52	Gastric ulcer	8 hours	45 minutes	4 days	24 days	31 days	47 pounds in 8 months	Moderate gastric retention—1 year 9 months	Acidity less than normal (1 yr. 8 mos. after operation)
4	47	Duodenal ulcer	3 hours	2½ hours	7 days	12 days	23 days	20 pounds in 9 months	No data	No data
5	37	Gastric ulcer	2½ hours	50 minutes	7 days	22 days	25 days	22 pounds in 1 year	No gastric retention—1 year	No data
6	38	Gastric ulcer	18 hours	1½ hours	5 days	22 days	23 days	Gaining in weight after 1 year	No gastric retention—1 year	Hyperacidity
7	44	Duodenal ulcer	1 hour	50 minutes	3 days	16 days	30 days	25 pounds in 2 months	Slight gastric retention—2 months	Well marked hyperacidity (2 mos. after operation)
8	44	Gastric ulcer	36 hours	45 minutes	"	"	"	"	"	"
9	26	Duodenal ulcer	3 hours	2 hours	10 days	14 days	18 days	Normal weight in 1 yr. 9 mos.	No gastric retention—1 year 9 months	Acidity approximately normal (1 yr. 9 mos. after operation)
10	28	Duodenal ulcer	5½ hours	4½ hours	21 days	23 days	26 days	No data	Slight gastric retention—4 months	No data
11	5	Duodenal ulcer	1½ hours	1 hour	8 days	22 days	25 days	Gained in weight in 2 months	No gastric retention—2 months	Test meal passed before it could be expressed
12	27	Duodenal ulcer (ulcer)	3½ hours	1½ hours	4 days	20 days	22 days	20 pounds in 2 yrs. 10 mos.	No gastric retention—2 yrs. 10 months	Acidity less than normal (2 yrs. 10 mos. after operation)
13	24	Gastric ulcer	2½ hours	45 minutes	5 days	25 days	28 days	12 pounds in 2 months	No gastric retention—2 months	Test meal passed before it could be expressed
14	21	Gastric ulcer	2½ hours	1½ hours	5 days	22 days	24 days	2 pounds in 3 months	Considerable gastric retention and ptosis of stomach—3 mos.	Acidity less than normal (3 mos. after operation)

* Case considered hopeless before operation. Saline infusion.

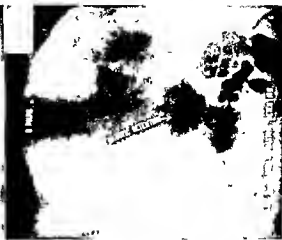
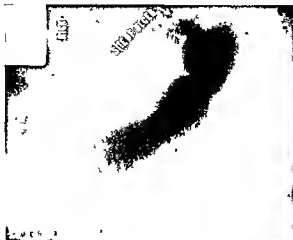
** Only case in which gastro-ostomy was performed. Patient died two hours after operation. (A true general peritonitis)

this statement, as in the same period of time we have had occasion to operate on 35 cases of acute intestinal obstruction

DIAGNOSIS

When seen early, the diagnosis of a perforation presents little difficulty. The frequent history of previous gastric disturbance, the violent onset with sharp stabbing pain more or less collapse, the boardlike rigidity of the abdominal muscles particularly of the upper abdomen, the possible vomiting of blood, are absolute characteristics. An additional but fleeting symptom I have observed in a few

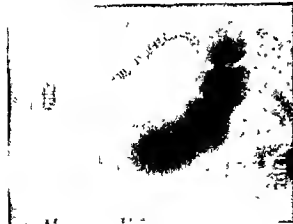
cases is a sharp pain coming usually within the first hour after perforation and referred to either supraclavicular fossa, chiefly the left, which lasts usually only a few minutes and disappears entirely. When the patient comes under observation later and in the absence of satisfactory history, while we can readily make a diagnosis of peritonitis the exact origin is not so clear particularly with the tendency of the extravasated material to gravitate toward the right flank and simulate a spreading peritonitis from a perforated appendix. In fact a considerable proportion of the cases of perforated gastric ulcer in the



Figs. 5 and 6 Case 1, roentgenograms taken 8 months after operation



Figs. 3 and 4 Case 2, roentgenograms taken one and a half years after operation



Figs. 1 and 2 Case 1, roentgenograms taken one month after operation

later stages are operated on, and perhaps always will be, for an appendix. The diagnosis, however, to the experienced operator is clearly obvious from the escape of gas, sour smell as opposed to colon bacilli smell, and the mucilaginous character of the fluid. Even if the incision is placed over the appendix, if the possibility of a perforated ulcer has been considered, one can increase the likelihood of recognition of this condition by opening the peritoneum under water, a procedure which I have used for a number of years.

The value of obliteration of the liver dulness as a diagnostic sign. This symptom I have never been able to recognize in any perforation of any kind of the gastro intestinal tract, and I feel it is a great pity that it is allowed to remain as one of the possibilities of diagnosis.

OPERATIVE METHODS

A description of these will comprise consideration of the following

- 1 Anæsthesia
- 2 Site of incision
- 3 Method of dealing with perforation
- 4 Performance or not of a gastro enterostomy
- 5 Cleansing of abdomen
- 6 Drainage

In outlining an operative program our ideal should be to perform a simple, easy, and quick operation which will jeopardize the patient's strength as little as possible, deal efficiently and safely with the present condition and, if feasible, forestall the continuance or occurrence of a gastric lesion.

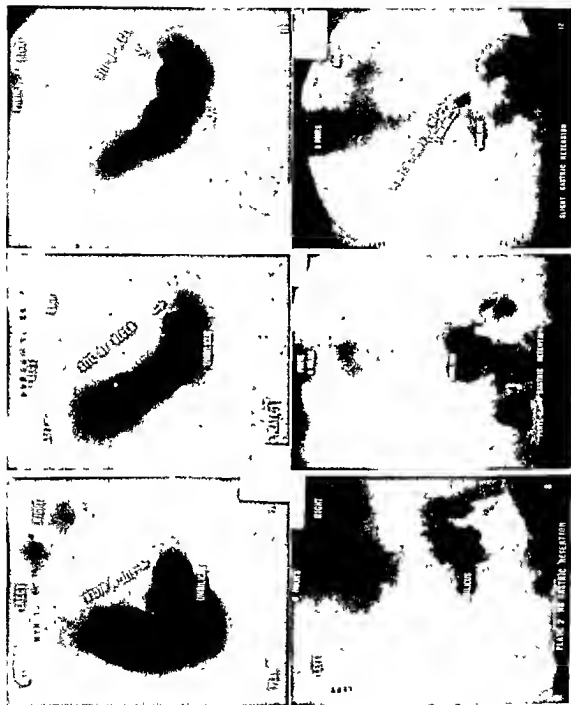
1 A general anæsthetic, preferably ether, is necessary. It may wisely be preceded by a generous hypodermic of morphine.

2 The great majority of perforations lie to one side or the other of the pyloric vein, proximal gastric, distant duodenal ulcer. An incision through the middle or outer border of the upper part of the right rectus muscle gives the most direct approach to the pylorus. It should be made quite large so as to allow for easy and quick recognition and access to the lesion. The several layers are incised down to the peritoneum. At this stage the edges of the muscular incision on either side are seized and held up by the assistant, thus

forming a crater, the bottom of which is the as yet unopened peritoneum. Two fine Kocher clamps seize the peritoneum, the crater is filled with fluid, the knife nicks between the two clamps, and any gas in the peritoneal cavity is obvious, coming out as bubbles through the layer of water. Ordinarily the presence of gas is sufficiently obvious, but with a very minute perforation and a very small amount of air this procedure will give a certainty, and of course it is of great advantage to get this definite information as we know that we must absolutely find a perforation whose existence is demonstrated by this test. Knowing where the lesion should be, we at once expose the pylorus when the perforation, situated anteriorly, becomes easily recognizable. The average perforation is at the center of an indurated area and is of such a size as to be clearly recognizable. Some of these perforations may not exceed the caliber of a steel knitting needle. If there is any difficulty in locating the perforation, pressing the gas from the stomach usually makes it obvious. In difficult cases insufflation of the stomach will help.

3 It is only exceptionally that anything more than a double purse-string suture of catgut is required to close the perforation. In order to get away from the friable indurated edges it may be necessary to make this purse string rather wide. If possible it should be applied across the diameter of the viscus rather than lengthways for fear of narrowing the outlet. I believe that actual stenosis of the pylorus very seldom follows, even in cases where apparent kinking from the suture seems to result.

Case 12 shows very well that an apparent obstruction, the result of suturing of the perforation, does not necessarily cause subsequent constriction. In this case two simultaneous perforations of the duodenum were separately sutured with a purse string and some constriction was apparently produced. X-ray examination nearly three years after operation shows no gastric retention in the six hour plate and the patient has gained twenty pounds. It is interesting to note also that the acidity of the gastric contents is less than normal.



Figs 7 and 8 Case 5, roentgenograms taken one year after operation.

Figs 9 and 10 Case 6, roentgenograms taken one year after operation.

Figs 11 and 12 Case 7, roentgenograms taken 2 months after operation.

One must remember that this narrowing is not a circular constriction but applies only to one face of the viscus, and we know by experience the tendency of these slighter distortions to become smoothed out. I have no experience with the more complex methods of closure and have never seen an indication for excision of an ulcer. Theoretically, it might seem that excision of an ulcer was indicated, but my experience leads me to believe that ulcers treated as I have described above show little tendency to give rise to future trouble. I feel distinctly authorized to make this statement as the result of the study of the series of cases now under consideration. My chief reason for thinking that such ulcers do not give rise to further trouble, lies in the belief that the perforation of an ulcer is *per se* a curative process. The perforation means usually the separation of the necrotic tissue with a natural tendency to union of the healthy surfaces left after the elimination of the foreign material.

4 The performance or not of a gastro-enterostomy is perhaps the subject which is most actively under discussion in connection with acute perforations of the stomach and duodenum and there is still wide divergence as to the proper attitude. My belief is that there would not be so much discussion if more care had been given to studying the end-results of operations for these perforations. I found statements regarding the after condition of patients to be rather vague, incomplete, and wholly unsatisfactory as regards definite information, and I found a total absence of any study such as I have made in this series of cases and from which I largely base my opinions. The indications, certainly theoretically for performing gastro-enterostomy are (1) to remedy any possible obstruction of the pylorus resulting from the methods of closure or the subsequent cicatrization of the ulcer and (2) to bring about the cure of the ulcer as the action of gastro-enterostomy in changing the chemistry of the stomach unquestionably is a curative measure for many ulcers and particularly those of the duodenum. I admit that gastro-enterostomy may rarely be indicated to forestall stenosis.

This series includes only one case of gastro-

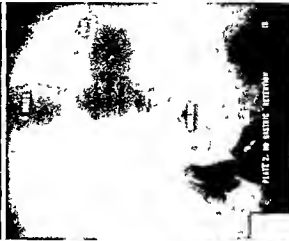
enterostomy performed with the belief that the repair had materially obstructed the gastric outlet, but as I have stated before the obstruction is probably more seeming than real and this view is borne out by the examinations which will be described later in detail.

I reject gastro-enterostomy as a curative measure in this class of cases notwithstanding that I have had very gratifying experiences with it in the cure of chronic ulcer. I consider it unwise to do gastro-enterostomy for a condition which is going to be cured anyhow. In a very small number of cases in which gastro-enterostomy may possibly become necessary, it can be wisely postponed until its indications are clearly recognizable. The small number of cases in which it may become necessary will probably be balanced by the number of cases in which the gastro-enterostomy fails to prove satisfactory, either because it is improperly placed, too small (subsequent shrinkage), too large (a very disagreeable condition), or the rare but exceedingly grave gastrojejunal ulcer. Moreover, in dealing with acute perforations it seems wiser to do only what is absolutely necessary and not subject the patient, who may have to struggle with a possible peritonitis, to an unnecessarily long operation, or risk the spreading of the infection by the performance of a gastro-enterostomy under imperfect aseptic conditions. The after-history of this series of cases contains no instance in which we have occasion to regret the omission of this step.

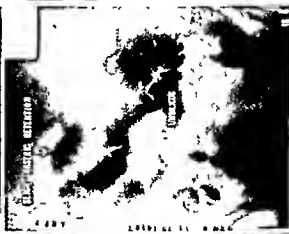
In the mass of recent literature on the subject three very interesting communications have dealt particularly with this subject. Eliot¹ summarizes a painstaking investigation as follows:

That on the other hand, so many patients are evidently completely cured by the closure of the perforation that they remain in good health for such a long time afterward and taking into consideration moreover the fact that, gastro-enterostomy for either benign stenosis or ulcer is no guarantee against future perforation or fatal hemorrhage, the conclusion seems warranted that where an immediate gastro-enterostomy is not indicated by prior constriction of the pylorus or by constriction resulting from the necessary closure of the perforation it is on the whole best to omit that operation until the future can decide whether the per-

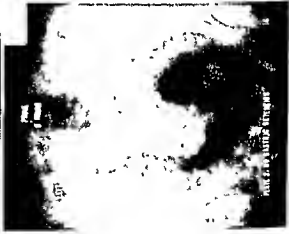
¹ Ann. J. Surg., vol. 6, October.



Figs 27 and 28. Case 11, roentgenograms taken a month after operation.



Figs 35 and 36. Case 20, roentgenograms taken 4 months after operation.



Figs 13 and 14. Case 9, roentgenograms taken one year after operation.

sistence of the gastric symptoms or their recurrence will render it necessary or not

Deaver¹ is a strong advocate of gastro-enterostomy. He says "Infolding of a duodenal ulcer, if complete, is usually impossible without serious obstruction to the viscus. Therefore, gastro-enterostomy is essential." In six years he has had 25 operative cases with 1 death. I note, however, in that period of time that 6 of his patients died of this condition without any attempt at operation.

Collinson, in 1914, reported a series of 40 acute perforations of the duodenum with 13 deaths, 13 of the stomach with 7 deaths. He says "An infolding of the pylorus or duodenum which at the time appears to provide a considerable grade of stenosis subsequently gives rise to no subsequent obstruction." In 14 cases which he treated by primary gastro-enterostomy 9 are quite well, 1 since died of carcinoma, and 1 had excision of a large gastrojejunal ulcer. He makes five points about the performance of gastro-enterostomy. His fifth is "Both to those who are experienced and those who are not I would make the following suggestion—when in doubt, don't."

It must be remembered also that gastro-enterostomy is no certain protection against the future development of ulcer or perforation.

Exclusion of the pylorus after gastro-enterostomy. If for any reason gastro-enterostomy had been done the question may well come up whether it may be wise to occlude the pylorus. Theoretically this procedure should more completely give the ulcer a chance to heal with physiological rest and give a better guarantee of the integrity of the suture. The whole question of the necessity, value and efficiency of pyloric exclusion is still *sub judice*, and in my own mind I am far from clear as to its indications or the best means of performing it. I have not had occasion to apply it at any time in the treatment of a perforated ulcer, but I believe its possible advantages should be considered in the exceptional case, particularly one presenting an obstacle to the perfect closure of the perforation.

5 *Cleansing of the abdomen.* Depending on the duration and the size of the perforation, there will be a variable amount and nature of material. With very early intervention and a minute perforation there is only a little material immediately around the site of the perforation and this can be readily mopped up with pads. If there is a large amount of material, especially in the late stages, an attempt should be made to remove it so thoroughly as is feasible. In our operating room we have constantly available a suction apparatus, and by passing the tube to different parts of the abdomen fluid is readily evacuated. I am not in favor of washing out the material, lest the infection be spread.

6 *Drainage.* Many, perhaps most, operators rely on some form of drainage. I used to use it freely but have discarded it entirely of recent years during which my results have improved. The drainage may be *in situ*, tube or gauze led down to the site of intervention. It is possible that in a case of very unsatisfactory closure a prophylactic drainage tract might be established. Drainage of the pelvis by a separate stab wound is advised by many. Some operators also recommend the evacuation of the stomach with a tube after closure of the perforation.

AFTER-CARE

My own practice probably varies from that of many other operators, but I have had reason to feel satisfied with its results, as a great bulk of these patients operated on by simple, rapid method without gastro-enterostomy give a particularly speedy and comfortable convalescence. Two thirds of the cases were out of bed in 15 days or less. In the first twenty-four hours the treatment is that usual to abdominal operations, nothing by mouth, semirecumbent position, Murphy drip. On the second day, water and other clear fluids in increasing amounts. By the fifth day the average case is allowed soft solids. At the time of discharge from the hospital all the patients were able to take and did take regular hospital diet. I insist particularly on this point because I think it is about time we got away from the fetish of underfeeding or of the particular value of

¹Tr. Phila. Acad. Surg. 1914

Feels well Ewald Amount 40 ccm, hydrochloric acid 0, total 10, combined 5 guanic none

X ray findings No gastric retention (Figs 19 and 20)

CASE 13 *Previous history* No history of gastric disturbance

After condition Two months post operative No pain Eats everything Has gained 12 pounds I walk passed before it could be expressed

X ray findings No gastric retention (Figs 21 and 22)

CASE 14 *Previous history* Gastric disturbance dating back one month

After condition Three months post operative General condition much improved Gained 7 pounds Eats anything Occasional pain in epigastrium but no gas or vomiting Ewald Amount 30 ccm, hydrochloric acid 48 total 93, guanic, none, very few food particles

X ray findings Considerable gastric retention Pto-sis of stomach (Figs 23 and 24)

It has seemed necessary, however, to offer more definite evidence of the good condition of our patients than is contained in the above statement and in Table I. So far as is feasible with these hospital patients in a large city we have tried to have them return for gastric analyses and X-ray pictures of their stomachs. Most of these examinations are of very recent date, forming for the earlier cases a valuable end result. Twelve of the cases have had bismuth pictures of the stomach, and the findings are shown in the accompanying photographs. Seven cases show no gastric retention at all. Two cases show only a negligible trace. Of the three other cases only one shows a considerable amount and the cause of this is quite likely to be a marked pto-sis of the stomach. Case 10 shows a slight retention, notwithstanding a functioning gastro-enterostomy. In none of these cases is there any evidence objective or presumptive of any appreciable stenosis of the pylorus or duodenum.

Ten patients have had gastric analyses. In two cases the gastric analyses could not be carried out because the Ewald meal was passed so quickly. This evidence, however, is valuable as showing the total absence of obstruction to the gastric outlet. In three cases the gastric analyses show acidity to be approximately normal, in three cases there was well marked hyperacidity; in two cases the acidity was less than normal.

CONCLUSIONS

1 The most important feature in the consideration of acute perforating gastric and duodenal ulcers is a prompt recognition and operation. Patients operated on within a few hours say two to four, should not have a mortality much in excess of 5 per cent.

2 As a routine only the simplest, speediest but sufficiently efficient operative procedure should be employed.

3 Such operations as resection of the ulcer and gastro-enterostomy should be the exception and performed only under very distinct indications chiefly to overcome definite stenosis produced by closure of the perforation. It must be remembered that many artificial stenoses are apparent rather than real. Operations such as resection or gastro-enterostomy intended to bring about the cure of the ulcer, are really unnecessary, as a careful study of the cases treated by the ordinary measures shows a tendency to spontaneous cure of the ulcer as a result of the perforation. It might almost be said that the perforation is a blessing in disguise. To judge properly of the value of operative procedures all cases should be carefully followed with accurate records of the findings. Analyses made from such records dispel many of the loose and inaccurate views now held.

THE TROPHIC ELEMENT IN THE ORIGIN OF GASTRIC ULCER¹

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IT has been found that gastric ulcer can easily be produced by the following conditions

1 By lesions of the central nervous system

2 By lesions of the gastroduodenal nerves; i.e., disturbing the innervation of (a) the vagus cervicalis, thoracic subdiaphragmatic, (b) the sympathetic nervous system in the rami which communicates between the fifth and ninth dorsal vertebrae in the thoracic and subdiaphragmatic splanchnic nerves in the solar plexus and in the lumbar chain

3 Through local circulatory disturbances by means of embolism

4 Through ligation of the portal veins

5 By removal of the adrenals (1)

6 By trauma of the epigastric region

7 By direct trauma of the stomach

8 By artificially produced hæmoglobinæmia

9 By anemia produced by pyrocin

10 By the ingestion of bacteria

11 By intravenous injection of bacteria

12 By intravenous injection of bacterial toxins

13 By intravenous injection of mineral poisons and autolytic toxins

14 By intravenous injection of adrenalin

15 By injection of adrenalin into the wall of the stomach

16 By cutaneous burns

17 By artificially produced insufficiency of the pylorus and ingestion of the tripan

The above methods have been used singly or in the following combinations: (1) Joint resection of the vagus and sympathetic nerves, (2) trauma and ingestion of 0.5 per cent hydrochloric acid, (3) trauma and anemia produced by graduated bleeding, (4) trauma combined with bacterial infection, and (5) resection of the cervical spinal cord combined with injection of 0.5 per cent hydrochloric acid.

It must be borne in mind that whereas some experiments yield positive findings

control experiments often give negative results. This has been especially true of the experiments dealing with the disturbance of the vagus or the sympathetic nervous system.

It will be readily understood that with the extensive experimental material at their command, the defendants of any given theory could easily cite facts apparently proving their conception to be correct while the opponents could as easily collect contradictory evidence. Hence no theory has gained general acceptance since no conclusive evidence could be brought forward in any one single case. To make evidence conclusive, gastric ulcer has to be reproduced in animals.

As far as is compatible with the peculiar morphology of the species, the lesion created must be a destruction of tissue identical in animals in so far as anatomic and pathologic structure is concerned, with acute and chronic ulcer in man.

The pathogenetic problem. The lesion must occur under conditions similar to those needed for the formation of ulcer in man. Under normal conditions the vitality of the gastric mucosa is directly dependent on three factors: secretion, circulation and innervation.



Fig. 1. Rabbit's stomach six hours after resection of left middle splanchnic nerve. Extensive hemorrhagic condition of mucous membrane.



Fig. 2 Hemorrhagic lesion of mucous membrane from blood vessels of muscularis mucosae. Rabbit's stomach two hours after resection of left small splanchnic nerves (X60) Hamalovyan eosin stain

tion, the latter being the result of the two former, inasmuch as the secretory glands are stimulated by nerve impulses and food supply, through their innervation and blood-vessels. In order to obtain a "clean experiment," we must create a disturbance in one or more of these three fundamental factors, thus attacking the life of the cell at its very roots.

Secretion. The pathogenetic value of the gastric juice (if the latter can be considered a cause of gastric lesions through autodigestion of the mucosa) is by no means clear. This may be the result of one-sided conceptions. Faulty clinical deductions, stating that gastric ulcer must be accompanied by and originate from hyperacidity, have suggested the following series of experiments: (a) Giving hydrochloric acid by mouth over a prolonged period, (b) the use of subcutaneous injections of hypertonic sodium chloride solutions intended to increase the actual amount of hydrochloric acid in the gastric juice.

Only negative results were obtained by these methods which were bound to result in failure since the premise that acute digestion is the result of hyperacidity is itself based on misconception. If we are to accept the theory that destruction of tissue can be caused



Fig. 3 Hemorrhagic lesion from violent rupture of the blood vessels of muscularis mucosae and destruction of the mucous membrane. Rabbit's stomach two hours after resection of right and middle splanchnic nerve (X60) Bensley's stain for zymogen granules

by autodigestion, more accurate knowledge of the actual chemical value, possessed by each of the various components of the gastric juice, should lead us to attribute these lesions of the mucosa either to an excessive production of peptic or to an insufficient quantity of antipeptic ferment.

Both hyperacidity and hypo-acidity are met with in gastric ulcer and should rationally be considered useful and natural measures of defense, counterbalancing the corroding effects of the pepsin, since Pavlov's experiment has proved that *in vivo* as well as *in vitro* the activity of pepsin is inhibited both by hyperacidity and hypo acidity.

If any influence on the course of gastric ulcer can be ascribed to the gastric juice—and we may readily conceive that it cannot be entirely without effect since gastric ulcers appear in that part of the digestive tract which is constantly brought into contact with the gastric juice or in places that have been artificially put under similar conditions (gastro enterostomy)—we are logically bound to attribute this influence to the action of the gastric ferments whose chemical activity has not thus far been clearly demonstrated.

Circulation. Among the experiments aiming at the reproduction of gastric ulcer through disturbed circulation, those blocking the minor vessels of the gastric mucosa by



Fig 4 Spastic condition of the blood vessels of muscularis mucosae. Incipient necrotic area in the mucous membrane. Rabbit's stomach six hours after resection of left middle splanchnic nerve ($\times 60$) Bensky's zymogenic stain



Fig 5 Ulcer, healing by proliferation of surface mucous cells. Rabbit's stomach 25 days after resection of all right splanchnic nerves ($\times 130$) Mucin stain

means of embolism have given the most satisfactory results. No results have been obtained by obstruction of the larger gastric and duodenal vessels. The following explanation seems admissible for the phenomenon: the larger vessel can reestablish a sufficient circulation by means of collaterals; the small vessels, on the contrary, though they cannot be called "terminal" in the true anatomical sense are in reality "terminal" from a functional point of view, and are incapable of supplying a sufficient collateral circulation.

The formation of gastric ulcer on the basis of embolic obstruction in the minor vessels of the gastric mucosa has proved conclusively that a disturbance of circulation in these vessels is in itself sufficient to produce typical circumscribed necrosis of the mucous membrane, the necrotic area thus formed is conical in shape, its base being nearest the surface, and presenting after removal of the slough the true picture of gastric ulcer. Ulcers thus produced are, as shown by the mitral lesion and by their subsequent development, an exact replica of only acute human ulcer. They end in the formation of a scar with a complete regeneration of the mucosa at least in such animals as survive operation for a sufficiently long period. Every attempt at thus reproducing chronic ulcer has resulted in

failure. If, as has been shown, the pathogenesis of acute ulcer may be explained by circulatory disturbances of embolic origin, this explanation has proved inadequate to solve the problem of the origin of chronic gastric ulcer.

Innervation. Physiology has not yet clearly established what phenomena in the various phases of gastric motility and secretion are to be attributed to the influence of the vagus or the sympathetic nerves respectively. This is probably due to the fact that both systems of innervation are so intimately associated, that it is practically impossible to stimulate the one system by itself and prevent the action of the stimulus from being transmitted to the other.

Recent investigations have shown that both systems of innervation are equally involved in the regulation of secretion and motility, both exerting an exciting and restraining influence at the same time.

The sympathetic nerve, moreover, apart from the functions in which it co-operates with the vagus, also controls the circulation of the vasomotor nerves of the stomach and carries impulses of profound sensibility to the central nervous system. Owing to the part which the sympathetic nerve plays in the nutrition of the gastric mucosa by regulating its circulation the title of "trophic nerve" is applicable to it in the most literal sense.



Fig 6 Small typical callous ulcer in the pyloric region. Both edges are composed of young proliferating connective tissue. No trace of epithelial regeneration. Dog's stomach 35 days after resection of all the three left splanchnic nerves. (X60) Weigert van Gieson stain.

As has already been stated attempts to reproduce gastric ulcer by means of disturbed innervation results in a great diversity of findings, and if positive and negative results cannot actually be said to contradict each other, at least the latter contain many new suggestions for the unravelling of the problems in question.

Although lesions presenting all the anatomical features of acute human ulcer could be produced it did not seem possible to obtain the true chronic form. The only description of artificial ulcers presenting anatomical features of chronicity and produced by disturbed innervation, may be found in Dalla Vedova's (2) monograph, these were obtained either by injecting alcohol into the splanchnic nerves, or by resecting these nerves after laparotomy.

Personal findings (3) Dalla Vedova's method suggests the following criticism. Ulcers forming after a laparotomy has been done cannot be said to be the direct result of nerve resection only as the manipulations needed to reach the nerves are bound to disturb and damage the surrounding viscera. It need hardly be emphasized that the operative technique is of primary importance in experiments of this kind, but even with faultless technique the fact remains that lesions which, under normal conditions of



Fig 7 Large callous ulcer in the pyloric region of same specimen as Fig 6 (X70) Safranin stain.

circulation and innervation, might be of little consequence are bound to give rise to severe complication when the nerves themselves have been tampered with. To defend my experiments against these very valid objections I have chosen the lumbar route for operation and attacked the splanchnic nerves extraperitoneally with one incision in the middle space of the costovertebral angle. This method though by no means easy, excludes all damage to the viscera, and also enables one to resect the large, the medium or the small splanchnic nerve individually. I have used dogs and rabbits for my experiments with a view to comparing the results to be obtained in animals presenting different types of morphologic evolution and dependent on a different diet for nutrition.

The following results were obtained after resection (75 experiments) of the right and left splanchnic nerves.

1 Neither subsequent hæmorrhagic nor necrotic lesions were found to occur after resection of the major splanchnic nerve during a period of observation lasting from one to one hundred twenty five days. Immediately after operation however signs of congestion might be seen in the gastric mucosa which cleared up in about ten or twelve days. Slight atrophy of the gastric cells more particularly of the zymogenic cells, remained.

2 Resection or ligation by means of silk thread, of the medium splanchnic nerve

invariably caused numerous circumscribed hæmorrhagic lesions side by side with non-hæmorrhagic lesions, presenting the characteristics of simple necrotic degeneration. These lesions we have found in the "cardiac pouch" in rabbits and in the pyloric region in dogs. Hæmorrhagic lesions of the pylorus and duodenum are rare in rabbits, while duodenal lesions are rare in dogs.

3 Resection of the minor splanchnic nerve occasionally resulted in slight hæmorrhagic lesions in the above-mentioned regions.

4 Simultaneous resection of both medium and minor splanchnics caused lesions identical with those already mentioned.

5 Combined resection of the three splanchnic nerves produced lesions identical with those described for the medium branch, only more pronounced in character.

6 Whenever the medium splanchnic nerve alone was resected or ligated, signs of hæmorrhage and intense congestion of all the blood-vessels were seen in the adrenal of the corresponding side, in both medulla and cortex; but those changes did not occur if the major splanchnic nerve alone was resected.

Macroscopically, the hæmorrhagic lesions produced by resection of the medium splanchnic nerve have the appearance of small dark specks which are sometimes grouped together so as to form circular hæmorrhagic areas from five to ten millimeters in diameter. These areas may be seen a few hours after operation (Fig 1). In the various stages of their development the initial lesion appears to be due to a minute lesion in a blood-vessel of the muscularis mucosæ, from this point the hæmorrhage spreads, infiltrating and destroying the mucosa. The hæmorrhagic area becomes conical in shape, its base coincident with the surface of the mucous membrane (Fig. 2).

Sometimes the force with which the hæmorrhage starts is so great that its mere mechanical action suffices to rupture all the layers of the gastric mucosa as seen in the stomach of a rabbit which died about six hours after operation (Fig 3). The two varieties of hæmorrhagic lesion; i.e., hæmorrhagic specks and groups of these, heal without any apparent connective-tissue reaction, through regen-

eration of the gastric mucous epithelium, the latter growing down along the edges of the ulcers and lining the cavities (Fig 4).

In lesions resulting from direct injury to the mucosa, healing is far more rapid. In these the epithelization of the ulcerous cavity is not complete even twenty-five days after operation. This seems to justify the conclusion that disturbed innervation not only causes circumscribed hæmorrhages but also results in a slight alteration of the entire mucosa. Careful observation reveals the histologic features to consist in a slight degree of atrophy of all the cells, especially of the zymogenic cells and a certain amount of distortion in the formation of gastric glands. This points to a process of retarded regeneration.

As stated above, necrotic areas as well as hæmorrhagic lesions are found in these experiments. The former are few in number and show macroscopically as small round pale areas. Their lack of color causes them to stand out sharply against the congested mucosa. Serial sections show these necrotic areas to have exactly the same shape as the hæmorrhagic lesions already described (Fig 5). They do not, however, contain the slightest vascular lesion nor show any sign of extravasation. Careful study of their subsequent course has led me to believe that they are the first stage of a specific kind of ulcer which I am about to describe and which presents all the characteristic features of true chronicity.

The gradual development and terminal stages of these ulcers can be traced with great accuracy in experiments on dogs. The accompanying photomicrographs (Figs 6 and 7) show two ulcers taken from the pyloric region of the same dog which died thirty-five days after resection of the three left splanchnic nerves. The lesions involve the mucosa and submucosa as far down as the muscular stratum; they show signs of infiltration and necrosis, no trace of epithelial regeneration can be found, the edges are covered with young connective tissue. Besides these ulcers, other lesions may be seen in the pyloric region, the latter all completely healed through a process of complete epithelization.

In these no connective-tissue reaction whatever can be observed. The results obtained offer the following points of discussion:

1. *Character of the ulcer.* As has been seen, disturbed innervation alone, without any additional trauma or infection, will suffice to create in animals lesions presenting all the essential characteristics of acute and chronic ulcer in man. These results are, of course, comparable only as far as their morphologic and histologic similarity is concerned. Clinical observations must need be valueless in dealing with different species. Comparison is made further impossible by the fact that animals survive these operations for a short time only and the lesions, being very extensive, are likely to be complicated by changes of metabolism. As we find chronic and acute ulcers in the same region of the same stomach, both originating at the same time, there is reason to assume that time does not play a paramount part in the process, i. e., that acute lesions do not take on chronic form, but that both varieties occur simultaneously and start as specific entities. Moreover, as both small and large chronic ulcers will be found in the same stomach, it is apparent that the size of the ulcer cannot be responsible for its insufficient healing.

2. *The origin of the ulcer.* A systematic study of the results obtained after resection of each splanchnic branch by itself seems to indicate that these nerves do not play identical parts in preserving the integrity of the mucous membrane. Resection of the major splanchnic nerve, although causing temporary paralysis of the gastric vessels is not in itself sufficient to produce permanently destructive lesions. The lesions obtained can only be compared with those resulting from resection of the medium nerve. At first sight this diversity of action seems contradictory, it is explained by the different degree in which the two nerves influence the blood pressure. It has shown that more telling effects may be obtained by stimulating the medium splanchnic nerve than are seen after stimulation of the large splanchnic nerve, even though the latter control the larger field in abdominal circulation, faradic stimulation being used in both cases. This apparent contradiction is

easily explained by the fact that the medium splanchnic innervates the adrenals; stimulation results in an increased secretion of adrenalin and, as the adrenal secretion has a physiologic as well as a selective action, it is one of the most powerful means by which contraction of blood-vessels can be produced. The results which I have obtained after resection of the medium splanchnic nerve only seem to illustrate the influence of this nerve on the adrenals, both by the rapidity (few hours after the lesion) with which the lesions appear and on account of the hemorrhages by which they are accompanied. Overstimulation, rather than insufficient innervation, seems to be the principal cause, for it must be remembered that intravenous injection of adrenalin has proved conclusively that by increasing the adrenalin content of the blood, hemorrhage can be produced in the gastric mucosa.

3. *The non-hæmorrhagic lesion.* To what cause are we to attribute the formation of the other, non-hæmorrhagic lesions? It does not seem logical to assume that they are due merely to circumscribed trophic disturbances if this were the case, they ought to be found principally after resection of the major splanchnic nerve, and they are not. The following explanation seems to me admissible namely, that we are dealing with spastic disturbances, due to the action of adrenalin and that whereas this action causes rupture of the blood-vessel in some points it leads only to spastic contraction in others. Klebs has already proved himself a warm defendant of the idea of "vascular spasm," which, however correct it may be, is unfortunately beyond conclusive proof as it cannot be made visible. By its very nature spastic contraction of a small blood vessel remains a functional disturbance and does not leave visible traces on the arterial wall.

SUMMARY

1. The peripheral innervation of the stomach can be said to be "trophic" in its action as it regulates circulation and stimulates secretion, besides transmitting impulses of profound sensibility.

2. Insufficient innervation of the gastric mucosa can be traced only after some time by

a slight atrophy of gastric cells. This fact may be explained by congestion and by a deficit in secretory impulses as the latter, in accordance with the laws of biology, are known to act as stimuli of nutrition and growth.

3 Trophic disturbances are not in themselves sufficient to cause ulceration, unless accompanied by vascular disturbances resulting in hæmorrhage or spastic contraction of the vessels.

4 Ulcers produced by resection of the vagus cannot be explained if we do not take into account the vasomotor disturbance by which they are accompanied. If the vasomotor disturbances accompanying them are duly taken into account, they may readily be explained by the transmission of nervous impulses to the sympathetic fibers contained in the vagus and by the numerous anastomoses existing between the two nerves which cause the stimulus to be transmitted from one nerve to the other.

5 Acute and chronic ulcers produced by resection of the splanchnic nerves develop with great rapidity, this is due to the fact that the operation irritates the nerves of the adrenal medulla in consequence of which greater quantities of adrenalin are forthwith secreted. The adrenal secretion stimulates the sympathetic nerve fibers, controlling the non striated muscles of the blood vessels, thereby causing the formation of hæmorrhagic and spastic lesions. Whereas the hæmorrhagic lesion, presenting the essential features of acute ulcer, heals by means of a scar, the spastic lesion becomes the starting point of genuine chronic ulcers.

6 Symptoms of deficient innervation appear only after specific characteristics of both types of ulceration are fully developed. Consequently nervous disturbances cannot be considered the primary cause of gastric ulcer, although it must be admitted that disturbed innervation plays some part in the subsequent development of the ulcers.

7. By resection of the splanchnic nerves ulcers may be produced in animals of which the histologic picture contains all the essential features of acute and chronic gastric ulcer in man.

THE ETIOGENETIC PROBLEM

Having reviewed the pathogenetic features of gastric ulcer and the numerous theories brought forward to explain them, the question remains to be discussed: Whether experimental work can be said to have furnished new suggestions corroborating or refuting the various conceptions of the etiology. It does not seem logical to assume that gastric ulcer should be caused by a single etiologic factor only, since we find it to be associated with the most widely divergent clinical syndromes, with symptoms of melæna neonatorum in infants, with trauma of the epigastrium region, nephritis and uræmia, burns, sepsis, toxæmia, oligæmia, bacterial infections, incarcerated hernia, tabes, malaria, tuberculosis, and lues. In the majority of cases, however, ulcers appear spontaneously; no apparent relation to other diseases can be traced. This type of ulcer, which exhibits all the most typical features of the disease, presents the greatest problems to scientific investigation; its etiology is of paramount importance. On the edges of some of these ulcers which had all the characteristics of true chronicity, and for whose formation neither clinical nor anatomical causes could be found, colonies of bacteria were discovered by Boettcher. The hypothesis contending that gastric ulcer is produced by the cytolytic local activity of bacterial toxins is based upon this observation. Other explanations of the fact seem, however, equally admissible, the presence of bacteria may as logically be considered the result as the cause of gastric ulcer, and the contention seems justifiable that the presence of bacteria in the wall of the stomach is merely an evidence of subsequent infection, since disturbed nutrition itself creates lessened resistance. Experimental work was brought to bear upon the question. Attempts were made to produce ulcer by feeding animals both with toxins and bacteria. The lesions thus created did not in any single instance possess the characteristic features of acute or chronic ulcer in man, the ulcers produced appeared to be mere foci of infection starting in the lymph-follicles of the gastric mucosa. Rosenow (4) alone succeeded in reproducing ulcers of the genuine human type by streptococci from human ulcer.

If the results obtained in experimental work do not exclude the possibility from an etiologic point of view of ulcers forming in consequence of bacterial infection (as the clinical observation of Boettcher and the experimental work of Rosenow seem to indicate) the fact remains none the less that bacteria are found in a limited number of cases only.

Owing to the important part played by nervous disturbances in the experimental formation of gastric lesions, ulcer appears, in the majority of cases, entitled to a place among the morbid causes due to a central and peripheric or anatomical factor. I have mentioned the central factor because, as is well known, excessive psychic stimuli are capable of so changing the normal vasomotor tonus that vascular disturbances culminating in rupture of the small arterial walls may be caused in any part of the body — a fact which may be explained by the close association, both in anatomy and function, of the sympathetic nervous system and cerebro-spinal tract.

The peripheral or anatomical factor must be taken into especial account since toxic stimuli — whether due to bacterial, to chemical or biochemical agents — are capable of

producing irritations in the sympathetic system, entirely comparable with those I obtained by means of surgical interference. In other words, ulcer may be produced by any agent capable of damaging the sympathetic nervous system as it is on the integrity of this system, which controls circulation, secretion, and profound sensibility in the stomach, that the very life of the gastric cell may be said to depend. The theory of "trophic ulcer" must be taken in this sense.

REFERENCES

1. MANN, E. C. A study of the gastric ulcers which followed the removal of the adrenals. *J. Exper. Med.*, 1916.
 2. VEDOVA, R. D. Ricerche sperimentali sulla patogenesi dell'ulcera gastrica. *Suppl. Policlin.*, 1900, VI, 1133.
 3. DECAESTE, L. Contributo alla fisiopatologia del nervo splanchnico. *Pathologica*, 1913, v, 631.
Idem. Contribution à la physiopathologie des nerfs splanchniques, en rapport avec la pathogénie de l'ulcère gastrique. *Arch. nat. de biol.*, 1913, 1st, 113.
 4. ROSENOW, E. C. The production of ulcer of the stomach by injection of streptococci. *J. Am. M. Ass.*, 1913, 1st, 1947.
Idem. Infective localization of streptococci. *J. Am. M. Ass.*, 1913, 1st, 1037.
- ROSENOW and BUSHORN. The bacteriology of ulcer of the stomach and duodenum in man. *J. Infect. Dis.*, 1913, 111, 410.

METASTATIC CARCINOMA OF THE OVARIES

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THE ovary has long been regarded as one of the frequent primary sites for the occurrence of malignant neoplasms, but until the beginning of the present century little attention was directed to the possibility of frequent secondary deposits in this organ, except as they appeared to be part of a general metastasis in the terminal period of the disease. In the American literature there appears to be scanty evidence that either pathologists or surgeons have accepted the newer conclusions which have been expressed in quite an extensive foreign literature. It is the purpose, therefore, of the present writer to review this literature and to add some material which he has examined in the Pathological Department of the Cornell University Medical College.

While some differences of opinion were evident prior to 1900, metastatic carcinoma of the ovary was, in general, considered to be of little pathological or clinical importance. Rokitsky (1) had observed, at times, cancer of the ovary as secondary to cancer of the uterus, breasts, and stomach. Billroth (2) said that his experience agreed with that of others that secondary cancer of the ovaries rarely occurs. Birch-Hirschfeld (3) and Olshausen (4) also concluded that it was of rare occurrence. Zahn (5), in reporting some rare forms of tumor metastasis, expressed the belief that, while the ovary is frequently the seat of cancer, it is rarely the seat of a metastatic growth. In the pathological institute at Genf, during the decade from 1877 to 1887, he found only four cases: three as regional extensions from the uterus and one as a metastasis from a distant organ, the breast. Leopold (6) however, noted the frequent association of malignant disease of the stomach with that of the ovaries without commenting upon their causal relations.

During the last decade of the nineteenth century a group of German writers in their efforts to uphold the monocentric theory of the origin of cancer, showed a causal relationship in numerous instances between tumors

which had previously been regarded as examples of the multiple appearance of primary independent growths. It was among these writers, apparently, that the literature relating to secondary cancer of the ovary began. Schimmelbusch (7), by showing the ease with which metastases may occur through the peritoneal lymphatics without giving gross evidence of their existence, materially reduced the number of apparently independent tumors of the abdominal organs. Bucher's (8) work suggests more emphatically than the other writers of this period the possibility of the frequency of secondary cancer of the ovary. He refers to nine cases in the literature, of which four were associated with carcinoma of the stomach, and five with carcinoma of the breast. Walter (9), commenting upon the simultaneous occurrence of cancer in paired organs, like the breast and ovaries, says that in the case of the breasts one tumor is surely secondary to the other, even if certain morphological differences exist, because modifications of histological structure are often noted in different parts of a tumor of the same breast. He thought it was more difficult to determine the relations in the case of bilateral tumors of the ovaries, but he concluded that the most common origin was the implantation of cancer-cells from the perforation into the peritoneal cavity of gastric or intestinal growths. Gebhard (10), in 1899, appears to be the first author of a textbook to express the view that secondary cancer of the ovary is probably more frequent than had hitherto been supposed. The ovaries, he says, seem to be an exception to Virchow's (11) dictum, that those organs which show a decided tendency to become the seat of protopathic tumor formation possess very little tendency to metastatic growth. An explanation, however, for the coexistence of tumors in widely separated organs, like the ovaries and stomach, or breast, he regards as impossible to make, because of our meager knowledge of the origin of cancer.

There appeared also during this period a

number of reports of cases in which ovarian tumors, diagnosed as sarcomata or endotheliomata, were associated with carcinomata of other organs. Bode (12), for example, presented a case in which a double fibrosarcoma of the ovaries, with areas having an endotheliomatous structure, appeared after an operation for the removal of a pyloric carcinoma. Fleischmann (13) reported the finding of a cancer of the pylorus at autopsy four days after an operation for the removal of a double fibrosarcoma (myxomatodes). In the discussion of this case, Temesváry (14) reported an autopsy in which he had found a fibrosarcoma of the ovaries associated with a carcinoma of the stomach, peritoneum, and retroperitoneal glands. He stated that he had found, of 300 cases of ovarian sarcomata in the literature, 4 with similar associations — 3 of the stomach, and 1 of the colon — in all of which both ovaries were involved. Lovrich (15) reported a case of ovarian sarcoma associated with a gelatinous carcinoma of the rectum.

A new interest in the relation of these cases to metastatic cancer of the ovary was created by the work of Krukenberg (16), who, in 1896, described his findings in 5 cases, to 4 of which, at the suggestion of Marchand, he applied the name "fibrosarcoma mucocellulare (carcinomatodes)." The fifth case, although having numerous appearances that were similar to the others, he classified as an endothelioma. Krukenberg says of these tumors that they are apparently always bilateral and usually accompanied by ascites. The entire structure of the ovary is involved, forming a large tumor which preserves in general the shape of the normal ovary. It is essentially a solid tumor, of firm consistency in the periphery, less so, even soft, in the center, dense areas, however, alternating with soft myxomatous parts throughout its entire structure. The surface is sometimes distinctly lobulated. The dense areas show histologically an excessive spindle cell growth of the ovarian stroma, justifying, he thinks, the diagnosis of a fibrosarcoma. In other less dense areas, due apparently to a mucoid degeneration, the stroma consists of a fine fibrillary meshwork, shading off into a

distinctly myxomatous structure. Throughout the different areas large epithelial-like cells are seen in large or small groups, sometimes arranged in single or double rows like a scirrhous cancer. In the myxomatous areas they may present an arrangement of larger alveoli. The cells differ widely in their size and shape — from large rounded cells with a well-stained nucleus and a slightly swollen body to those in which the protoplasm of the bodies is so swollen from the mucoid degeneration that the nucleus is pushed to the side of the cell into a seal ring shape. While appearing in certain areas to be of epithelial origin, Krukenberg says that he could nowhere find a connection between these cells and normal epithelial elements of the ovary. On the other hand, he believes the different forms of these cells appear to be simply transitional stages of mucoid degeneration of the stroma cells. Because of the extensive metastases in his first case, and particularly because of the similar character of the cells which he found distending the lymphatic vessels throughout the body, he is not definitely certain they are not carcinomata. The importance of Krukenberg's description and interpretation of these tumors appears in all of the subsequent discussion of the subject of metastatic ovarian cancer.

After an interval of five years from the time of Krukenberg's publication, during which little confirmation of his conclusions is found, Schlagenhauser (17), in 1902, made a notable contribution both to the interpretation of Krukenberg and to the entire subject of secondary cancer of the ovary. He collected and tabulated 71 cases from the literature, adding 8 cases of his own, as follows: 61 with cancer of the stomach, 7 with cancer of the gall bladder, 1 with cancer of the suprarenal gland. He directs attention to the clinical features and discusses their histological structure. Clinically, he observed that the ovarian tumors were almost invariably so large as to practically control the clinical picture. At operation, he says, the coexistence of a tumor in another organ was often not discovered, and even later the clinical signs of tumor were usually ascribed to metastatic recurrences from the

ovarian tumors. Tuberculous peritonitis has been the clinical diagnosis in several cases, and two had applied for treatment under the supposition that they were suffering from the vomiting of pregnancy. Both in his own cases and those from the literature, the clinical diagnosis had been invariably wrong. Regarding the pathology of these tumors, he interprets the "Krukenberg tumor," of which he had four cases, as of epithelial origin, the mucoid degeneration of the cells being a colloid degeneration because of their origin from primary growths of the gastric mucosa. He likewise included 15 cases of ovarian sarcomata or endotheliomata, as belonging to the class of secondary carcinomata of the ovary — the majority of the scirrhus type.

Since the publication of Schlagenhauser's work the writer has reviewed the reports of 133 cases in the literature, in which the descriptions were sufficiently complete to indicate that a causal relationship existed between the ovarian and the tumors of other organs, and in which, with few exceptions, the tumors of the ovaries were undoubtedly secondary. The primary tumors occurred among the different organs, as follows: stomach (18) 75, breasts (19) 25, large intestine (20) 22, gall bladder (21) 5, small intestine (22) 4, pancreas (23) 1, appendix (24) 1. In these reports numerous writers have discussed their occurrence and frequency, their clinical features, their pathology, and routes of metastasis.

FREQUENCY OF SECONDARY OVARIAN CARCINOMA

Bland Sutton (25) says that he agrees entirely with Schlagenhauser's conclusions, and that for twenty years he has been suspicious that bilateral cancer of the ovaries is frequently secondary, because he has noted the presence of massive deposits in one or both ovaries in 10 per cent of autopsies after mammary or gastric cancer. The majority of cases, he says, were operated upon under the impression that they were primary tumors, and the presence of a coexisting cancer of the gastro intestinal tract was overlooked

in spite of the presence of such typical signs as persistent vomiting and progressive emaciation. Bland-Sutton characterizes such errors as the result of an "occupation bias," by reason of which the pelvic surgeon allows the presence of a definite pelvic tumor to fill the foreground of the clinical picture, while the general surgeon, too intent upon a tumor of the stomach, will disregard the significance of enlarged ovaries. He has also frequently noted, as one of the remote results of operations for ovarian tumors, intestinal obstruction from an obturating malignant growth which has the typical characteristics of a primary cancer. Pathological reports alone, he deems as insufficient to determine the primary site, but they must be combined with a clinical history, giving assurance that from a careful examination a tumor of the gastrointestinal tract may be excluded.

Glockner (26) found during the years 1901 and 1902, among 14 cases of ovarian cancer, 6 associated with a cancer of some other organ. From a study of 18 cases, he concludes: (1) Secondary cancer of the ovaries is relatively frequent. (2) Most of the bilateral cases are secondary, especially of the scirrhus variety. (3) In the presence of a cancer of other abdominal organs, the ovarian cancer in the vast majority of cases is not primary, but a metastasis. He thinks the primary tumor occurs most frequently in the stomach, breasts, uterus, and gall bladder. In his own cases, 9 occurred in the stomach, 5 in the breast, 3 in the uterus, and 2 in the large intestine.

Stickel (27), from a study of 13 cases, concludes: (1) In every case of primary cancer of the breast, stomach, gall bladder, and large intestine, before an operation is undertaken, a thorough examination, especially of the ovaries, should be made. One must not disregard the possibility of their being affected because the peritoneum or retroperitoneal glands are not apparently involved. (2) If there is a suspicion that bilateral cancer of the ovaries exists, a most searching examination should be made for a primary cancer elsewhere. In the search for growths of the stomach or intestine, one must not be satisfied with palpation, for the primary

growth may be too small: every aid to diagnosis should be used.

Engelhorn (28) found in the Tuebingen clinic during the decade from 1897 to 1907, among 80 malignant tumors of the ovary, 13 which were associated with cancer of the stomach, and in all of which, he believes, the primary tumor was in the stomach.

Amann (29), from an observation of 13 cases, expresses his belief in the frequency of secondary ovarian cancer.

Goullioud (30) has met with 5 such cases, and considers that ovarian metastases are an important factor in the evolution of cancer of the stomach.

Pfannenstiel (31), who has been an ardent advocate of the frequency of the multiple appearance of primary cancer, says, in 1908, that he is convinced that in most cases of bilateral cancer of the ovaries, which are associated with cancer of the stomach or other organs, the ovarian tumors are secondary, and that he and Olshausen are wrong in their previous conclusions regarding the rarity of such metastases.

In spite of the fact that, from the writer's review of the literature, the breast appears to be the organ, next to the stomach, which is most frequently the primary seat, we find little discussion of its occurrence. Coupland (32), however, in 1876, among 80 mammary carcinomata, found 6 per cent with ovarian metastases, and Toerek and Wittelschofer (33), among 366 cases, found 7 per cent. Handley has confirmed these statistics, showing among 422 cases 6.7 per cent with ovarian metastases. His statistics are based upon the autopsy records of two hospitals, in one of which, as a special provision was made for cancer patients so that they remained throughout the course of the disease, the findings represent, in general, later stages of the disease. No such provision was made in the other hospital, and the records are mostly those of patients who have generally died at an earlier period in the evolution of the disease. His cases were, therefore, designated as "early" and "late," and certain differences in the percentages of invasions in the internal organs suggest some new facts. Of the "early" cases the ovarian

metastases were present in 4.8 per cent, while in the "late" cases they were present in 8.6 per cent. He found, furthermore, that, in the "early" cases, thoracic metastases alone were present in 10 per cent, and in the abdominal organs, without thoracic invasion, in 17 per cent; while, in the "late" cases, thoracic invasion alone was present in 22 per cent, and in the abdominal organs alone in 11 per cent. There were 53 cases, or 12.5 per cent, in which the invasion of the internal organs was limited to those strictly within the peritoneal cavity; and of these the liver was involved in 84 per cent, the ovaries in 11 per cent, the tubes in 2 per cent. In 2 of the 53 cases the ovaries alone were involved. Of 8 cases of multiple abdominal metastases, those in the liver were associated in five instances with a growth only in the pelvic organs. Handley's statistics agree with those of the older writers in the fact that, next to the liver, the ovaries are the most frequent sites among the abdominal organs. The peritoneum in Toerek and Wittelschofer's series showed involvement in only 5 per cent, while the abdominal lymph-nodes, showing a percentage of 9.5, slightly in excess of that of the ovaries, were undoubtedly, as Glocker (26) suggests, in numerous instances tertiary extensions from the liver, ovaries, or other abdominal organs in which metastases had already occurred. A suggestive comparison is also furnished in the statistics of Toerek and Wittelschofer, which show the supraclavicular and cervical lymph-nodes to be involved in a percentage of 6.3, slightly less than that in the ovaries. Sitzenfrey (35), who had been impressed with the clinical frequency of ovarian metastases in mammary cases before the appearance of Handley's work, suggested a possible additional therapeutic advantage in the performance of the Beatson operation.

Regarding the occurrence of secondary mammary cancer from primary abdominal tumors, there is little in the literature to suggest that it is more than a rare event. Plew (36) has collected six cases from the literature and added one of his own, but the data which he gives do not suggest a definite conclusion.

THE PATHOLOGY AND HISTOGENESIS OF
SECONDARY OVARIAN CARCINOMA

The discussion of the pathology of these tumors is found to be closely related to the interpretation of the histogenesis of the Krukenberg tumor. Wagner (37), almost simultaneously with the publication of Schlagenhauser's work, reports a case of malignant tumor of both ovaries as secondary to a cancer of the pylorus in which, he says, the histological structure of both the ovarian and the pyloric tumors was typical of sarcomatous cancer with well marked colloid degeneration of the cells. From the similarity of their structure to that of the Krukenberg tumor he agrees with Schlagenhauser that the latter is a secondary and not a primary tumor deriving its characteristic growth of mucoid cells from its origin in the gastric mucosa. The same interpretation is given more decisively by Ulesko Stroganoff (38) in the records of three similar cases. She expresses doubt as to the primary nature of Krukenberg's first case and the one reported by Schenk (39) both of which are generally accepted as primary. Wermuth (40) in discussing ovarian sarcoma and its complications says of the Krukenberg tumor that it shows a mixture of epithelial and connective-tissue cell growth representing a metastatic cancerous invasion to which the ovarian stroma reacts with a sarcomatous proliferation. Amann (29) in his work upon secondary ovarian cancer refers to 15 cases in the literature almost all of which he regards as metastatic colloid carcinomata from a carcinoma of the stomach or intestine. Among such cases he says are several endotheliomata or sarcomata which are instances of secondary cancer. He reports 4 cases of Krukenberg tumor of his own as secondary. Stickel (27) also from the similarity in the structure of several of his cases of secondary ovarian cancer to that of the Krukenberg tumor, believes it is a metastatic tumor. Glockner (41) in his contribution to the pathology of solid ovarian tumors describes a typical Krukenberg tumor, which appears undoubtedly to be primary and in which the mucoid cells are most probably derived from the stroma cells of the ovary.

He does not regard, however, such cells as specific for a certain form of tumor, as he has found similar cells in ovarian tumors that were secondary to a cancer of some other organ. He also describes mucoid cells in other cases of primary ovarian tumors, particularly in one which he designates as an endothelioma which he acknowledges may be easily confused with the carcinomata, sarcomata, or Krukenberg tumor. The conclusion, he says seems warranted that the ovary, in both its epithelial and its connective tissue cells, possesses a great tendency to mucoid degeneration. Pfannenstiel (31) says that many of the Krukenberg tumors, including some of those reported by Krukenberg himself were undoubtedly secondary to intestinal carcinomata. Bondy (42) reports 4 cases of undoubted metastatic cancer of the ovaries which in part, have the structure of a Krukenberg tumor, and in part that of an endothelioma. Fischer (43) describes two Krukenberg tumors both of which he regards as primary. Cohn (44) records 4 cases, 2 of which were secondary to a cancer of the pylorus and the others were also probably secondary. In the American literature we find the record of a case by Schwarz (45) occurring in a patient 30 years of age. Both ovaries were involved, and she died without clinical evidence of intestinal disease. The failure to obtain an autopsy in the case of Outerbridge (46) also makes its origin uncertain. He carefully describes the histological features of his case showing by the use of different stains for mucus that the cells are derived from those of the stroma and, therefore designates the tumor as a fibro-sarcoma undergoing myxomatous degeneration. The striking similarity in the histology of certain forms of primary ovarian cancer to that of the Krukenberg tumor is quite definitely demonstrated by Gebhard (10) in his description of a group of primary ovarian cancer, which he designates as a "diffuse carcinoma." In this group, he says, the distinctly alveolar arrangement is to a great extent lost and more of an embryonal condition becomes evident by a closer blending of the epithelium and connective tissue. The epithelial elements are arranged so as to

regularly in the bundles of connective tissue that they present pictures remarkably like those of a sarcoma. Under a high power, however, the epithelial nature is evident, and in certain areas the arrangement is more regular, so that a small alveolar structure is manifested in which the lumen is often filled by swollen, transparent cells with the nuclei pushed to their peripheral edge, furnishing often an appearance of primordial follicles. In the stroma there are also found degenerative changes. This description seems to the writer to be especially suggestive because Gebhard makes no reference to the interpretation of Krukenberg.

Numerous writers have attempted to distinguish the pathological anatomy of the secondary tumors from that of the primary. Amann (29), using as a basis his observations in 18 cases, describes three types of metastatic cancer of the ovary: (1) Edematous fibromata with epithelial infiltrations which are often sparsely diffused as compared with the marked growth of connective tissue, presenting adenocarcinomatous or carcinomatous columns the cells of which frequently show a colloid degeneration resembling that of a carcinoma of the gastrointestinal tract. Amann records 6 cases of this type in which the excessive growth of connective tissue cells represents a fairly constant reaction of the ovarian stroma to the infiltrating cancer cells, as noted also by Krauss (47), Schlägenhauser Polano (48) and Glocker (26) and to which has been ascribed the enormous size of these tumors as compared with the small primary growths in the other organs from which they are derived. Amann says that the cellular growth of the stroma is especially marked in the peripheral areas, while the edematous changes are more extensive in the central parts. But even in ovaries, scarcely changed macroscopically, as, for example in a case secondary to a primary mammary cancer, he noted small adenocarcinomatous foci surrounded by a shell of strongly growing connective tissue. (2) A nodular medullary type, consisting of more or less solid nodes of an adenocarcinomatous structure. (3) Cystomata, with scattered deposits of a fibrocarcinomatous structure.

In the two latter types, Amann says, there is often also a marked edema of the connective-tissue areas, and expresses the opinion that, because of this reaction of the stroma, much of the confusion has arisen relative to the diagnosis of certain sarcomata and endotheliomata. With this view Roemer (49) and Polano (48) agree, the latter designating numerous cases as "pseudo-endotheliomata."

The nodular type appears to be the characteristic form in which metastatic cancer of the ovary occurs. Gebhard (10) says it is most frequently located in the center of the ovary, at times in the form of multiple nodes, and that the carcinomatous masses appear more frequently than in other ovarian tumors, as long, narrow alveoli penetrating the ovarian stroma. Glocker (26) has shown in the cut-section of only slightly enlarged ovaries one or more circumscribed cancerous foci which may appear apparently, in any part of the ovarian stroma. Stükel (27) also, shows how such circumscribed nodes, recognized macroscopically, correspond in general, microscopically, to the cancerous areas although cancer cells may be seen infiltrating the tissues outside of the nodes. In 5 of Stükel's cases the tumors have reached a large size and the ovarian structure has become diffusely infiltrated. In other cases it is possible according to the age of the metastases to follow the advance of the cancerous invasion from circumscribed foci to an increasing number of infiltrating paths until finally the entire structure becomes involved. Cyst formation was noted in some of Stükel's cases, in one of which they were so numerous as to be designated as a cystadenocarcinoma. Pfannenstiel (31) says that metastatic carcinomata of the ovary regularly present features which distinguish them macroscopically from primary tumors. He says they are mostly dense nodular tumors of about the size of the fist and in the majority of cases are double-sided (2 of his 31 cases). Their histology varies with that of the primary tumor and the age of the secondary growth. In the early cases the epithelial infiltrations are few as compared with the growth of the stroma in which they are embedded as small nests or long narrow alveolar like pro-

cesses, simulating, at times, the appearance of an endothelioma Pfannenstiel confirms Amann's description of his first type, in which the growth of the stroma is so excessive as to appear like a fibroma, in the central parts of which the oedematous condition may give this area a soggy consistence

The failure of both Glockner and Stickel, even in the early cases, to detect a proliferation of the normal epithelial elements of the ovary may be accepted as corroborative of their secondary nature but the histogenesis of all ovarian tumors is frequently obscure and in the advanced cases the histology alone will not permit of a differentiation between the primary and secondary tumors

Most of the writers have satisfactorily shown a similar histological structure in the ovarian tumors and in those of the organs which they have concluded to be the primary site Within certain limits however anaplasia metaplasia reversion and various degenerative processes contribute to a well marked variation in the morphological features of all ovarian tumors thus accounting for much of the confusion that exists regarding their histogenesis Kuster (50) describes two ovarian tumors which were associated with a cancer of the pylorus The larger one contained a dermoid, and in both tumors were nodular growths containing three fairly well differentiated forms of carcinoma—colloid large alveolar and a sarcoma He discusses their origin from the three layers of the dermoid, quoting in illustration a case of Yamagata which originated from the presence of some atrophic mammary tissue but concluded from the autopsy that in his own case the primary site was the pylorus All of the forms he says however different they may appear are a complex of gland cells judged not by the morphological peculiarities of the individual cells but upon their arrangement, which shows a clear tendency to gland formation, more or less complete in different parts of the tumors In support of his conclusion Kuster cites the opinions of Ribbert (51) and Borst (52) regarding the influence of tissue resistance and nutrition in modifying the structural appearance in the metastatic invasions of a highly differentiated carcinoma

The colloid degeneration, for example, occurred most extensively in areas where the connective tissue septa are sparse and the vascular supply is poor Roemer (49), noting a difference in the size of the cells in a gastric and ovarian carcinoma, says such a criterion of the causal relations of two tumors cannot in itself be absolute Within certain limits the structure of the organ in which the cancer grows determines both its method of growth and the configuration of the cells He says the presence even of necrosis may not be significant of the priority of the tumor, as he observed in a gland in which the tumor was secondary to a carcinoma of the esophagus Further indications of the difficulty of distinguishing primary and secondary ovarian tumors, histologically, are furnished by Goodall (53), who, from a painstaking study of comparative embryology, histology, and the function of the ovaries, has offered evidence to support the theory that all epithelial neoplasms of the ovary derive their origin from fetal "rests," all of which represent metaplastic changes of invasions of the germinal epithelium, and contain tall columnar cells goblet cells true mucus cells, while still others have ciliated epithelium Glockner (41) also seems inclined to accept Walther's (54) findings in normal ovaries at different ages of various "embryonalanlage" containing ciliated cells, beaker cells and others, as indicating the origin of many epithelial tumors of the ovary

In spite of the numerous difficulties, however, that present in the determination of the causal relations between tumors, it seems to the writer that the question of structural differences has been given sufficient attention to indicate the accuracy in general, of the conclusions recorded in this literature The criticism therefore by Outerbridge (46) of Stickel's conclusions as to the frequency of metastatic cancer of the ovary, does not appear to be justified For example, in case 12 of Stickel's (27), in which a carcinoma simplex of both ovaries was evidently secondary to a similar tumor of the breast, there was also present an ulcerating adenocarcinoma of the ascending colon which was undoubtedly primary The case was therefore classed by

Stickel as one illustrating the multiple appearance of primary carcinoma. In fact, a definitely localized growth in either the gastro intestinal tract or the mammary gland is easily identified by a gross examination, and it is evident that, after giving due consideration to the histology and the failure to discern proliferation of the normal epithelial elements of the ovary, the primary site of the tumor has been determined in a majority of the cases by the gross pathology of the neoplasms in the other organs.

The comparative frequency of the different forms of carcinoma in these cases is undetermined, but that a large number, both of those in the gastro intestinal tract and of those in the mammary gland, were of the scirrhus variety, may partly explain the clinical prominence which the ovarian tumors have so uniformly occupied. A small slowly growing scirrhus of the pylorus for example, with few or no signs of its existence finally metastasizes in the ovary where under more favorable conditions it may assume a rapid and extensive growth.

All of the cases of metastatic cancer of the ovary, with few exceptions have been found to be bilateral many of them however giving little or no gross evidence of malignant invasion. The value of this as evidence of their secondary nature is diminished by the fact that primary ovarian tumors are also found to be bilateral in a large percentage of cases. The statistics show a variation from 25 to 50 per cent, but in these estimates secondary tumors have undoubtedly been included. The observations of Walthard (54) and Goodall (53), both of whom have noted that embryonal "rests" if present in normal ovaries occur uniformly in both organs also emphasize the necessity of withholding judgment regarding the value of bilateral involvement as evidence of a secondary nature.

THE ROUTES OF METASTASIS

The transmission of cancer from organs or tissues to distant parts of the body still presents one of the important problems of cancer research. Except for the recognition of local extension to neighboring structures

through the lymphatics, little attention has been given to the route of its further invasion except as a chance distribution by embolic transportation through either the blood or the lymphatic vessels. In the literature of metastatic cancer of the ovaries, we find much of importance in the discussion by which metastases occur between internal organs especially of the abdomen.

Retrograde transportation through the lymphatic vessels is accepted by Roemer (49), Glockner (26) Stickel (27), and Pfannenstiel (31), as the most probable route in the vast majority of cases. From a carcinoma of the stomach for example, these writers and others have demonstrated a continuous course of lymphatic invasion through the lymph vessels and nodes behind the stomach and pancreas into the retroperitoneal lymphatics along both sides of the aorta, to the enlarged lumbar nodes from which, through a reverse current in the spermatic lymph vessels the cells are transported into the ovaries through the hilum. This route is shown to be the only probable one in many cases in which no peritoneal implantations are discoverable. Schaeffer (55) records a case to show that as he thinks a metastasis may occur along this route in the reverse direction.

Peritoneal implantation, as a route for the spread of cancer among the abdominal organs was first suggested by Virchow (10) who said that from a primary growth of the stomach for example which has reached the serous layer multiple peritoneal nodes may be engrafted upon distant parts particularly in the region of the pelvic pouches. Bucher (8) is credited with being the first to suggest this way as possible for metastatic invasion of the ovaries from growths in distant organs. The publication however of Krauss (47) work giving the pathological findings in 5 cases and the results of his animal experimentation created an extensive discussion of the subject. The description of the histology in his cases appears to show conclusively that small cancerous invasions have occurred through the ovarian surface and from the presence of minute colored particles in the cortical areas of the ovaries of animals after a solution of India ink had been in

jected into their peritoneal cavities, Krauss concluded that the germinal epithelium is particularly suitable for cancerous invasion. Wolffheim (56) however, in repeating the experiments of Krauss, did not confirm this conclusion. On the contrary, he concluded from his own findings that the germinal epithelium is remarkably resistant to the penetration of corpuscular elements except at such places as had been injured by the bursting of a graafian follicle. Confirmatory of this opinion, he found an extensive penetration of the endothelial surfaces of the other abdominal organs and neighboring structures up to the line marking the existence of the germinal epithelium. The importance of Wolffheim's observations relates especially to the clinical fact, with which practically all of the observers agree that the age at which these metastatic tumors of the ovaries are found is during the period of the functional activity of these organs. Sitzenfrey (57) for example repeats the suspicions which he and Schenk had previously expressed that the operative results for carcinoma of the stomach because of the possibility of this method of metastasis, might be improved by removing all ovaries if the disease occurs while these organs are functioning. A case of Gottschalk (58) 55 years of age showed two metastatic nodes in an ovary otherwise atrophic one year after an operation for cancer of the body of the uterus but the metastases are most likely to have occurred by lymphatic extension through the hilum. Considering the number of cases recorded in which the histological descriptions are complete, it seems strange that a demonstration of invasions through the cortical layer of the ovaries has not been more frequently made. Even among Stickels (27) early cases he did not find one but they were not examined he remarks with the object of solving the question of peritoneal implantation. Glocker (26), also presented only one case in which he demonstrated a lesion similar in every respect to the findings of Krauss. In this case a growth of the stomach showing well marked mucoid degeneration of the cells, had penetrated the serosa. Numerous peritoneal implantations were present and the



Fig. 1. Case 1. Embryonal carcinoma of the ovary. Alveolar structure in peripheral area.

ovarian surfaces showed in places the invasions of an adenocarcinomatous growth, with mucoid degeneration of the cells similar to that in the stomach. In some places small particles of similarly constructed cells were clinging to the ovarian surface. Sitzenfrey (59) describes similar findings in a case, 35 years of age in which neither ovary gave gross evidence of the disease. Roemer (49) also records a case, 29 years of age, in which the ovaries and a puerperal uterus showed implantation metastases. The writer's review of Wolffheim's (56) observations suggests that the reason for the failure to demonstrate such lesions more frequently may depend upon the rapidity of the reaction of the ovarian stroma to the invasion of cancer cells and to their almost immediate inclusion by the processes incidental to the involution of the ruptured follicles. A microscopic penetration of the serosa in cases of a pyloric growth for example is suggested by Glocker (26) to account for peritoneal implantation in numerous instances in which there is no gross evidence of the extension to the peritoneal surface. Sitzenfrey (59) also suggests that in some cases a regional extension to the omentum may not produce a gross lesion but from its minute foci cancer cells may be scattered throughout the peritoneal cavity.

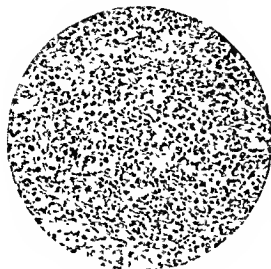


Fig 2 Case 7, Krukenberg tumor of the ovary. Diffuse growth of epithelial cells in different stages of mucoid degeneration mostly well advanced showing the typical signet ring form.

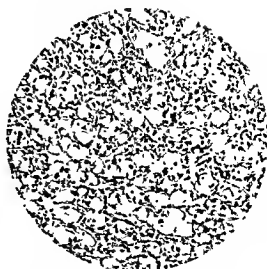


Fig 3 Case 7, Krukenberg tumor of the ovary. More advanced stage of mucoid degeneration, the stroma also shows a reaction and the structure has a myxomatous appearance.

The presence of ovarian metastases without evidence of peritoneal implantation of other organs has been offered by several of the writers as a serious objection to this mode of metastasis. Regarding this question, one may point to the location of the ovaries in the lower part of the abdominal cavity, particularly their close relation to the pouch of Douglas which Sitzenfrey (59) has designated as the sewer-trap, "Schlammfang," of the peritoneal cavity. Schnitzler (60) found in eleven cases of carcinoma of the stomach, for example, metastases in the anterior rectal wall just beneath the peritoneal layer. Rosenstirn (61) made examinations at the autopsies of 15 cases of malignant disease to determine the presence of implantation metastases in the pouch of Douglas—seven males and eight females. In the males none were found, but in five of the females they were present as superficial lesions just beneath the serous layer, either at the bottom or in the anterior and posterior wall. In one case, the youngest 34 years of age, in which the primary site was in the stomach the left ovary showed an alveolar invasion of the entire ovarian structure. The right ovary was large and contained an excessive amount

of connective tissue, but no evidence of cancerous infiltration. Peri-ovariitis and adhesions existed in the other cases. A case of Lubarsch is cited by Bucher (8) to show the protective action of such adhesions, one ovary only being the seat of cancer, the other being embedded in strong adhesions. In a case of Sitzenfrey (59) the only metastases outside of the ovaries were microscopic foci in the omentum and implantation nodes in the pouch of Douglas. Strauss (62) is so impressed with the possibility of the frequent presence of early metastases in the pouch of Douglas that he suggests that a pelvic examination in certain cases might be an aid in the differential diagnosis between a simple ulcer and a carcinoma of the stomach. Tilp (63) who has recorded a case with the primary site in the gall bladder, says that the predilection sites for implantation metastases, after the growth has penetrated the peritoneum are the pouch of Douglas, the vesico-uterine pouch, the insertion of the mesentery to the intestines, and the surfaces of the ovaries. Both the gross and the histological evidence is against either the hematogenous or lymphatogenous route of invasion.

Regarding primary carcinoma of the breast,



Fig 4 Case 7 Krukenberg tumor of the ovary. An area in which a distinctly alveolar structure is seen

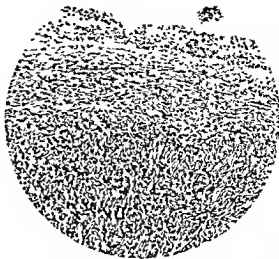


Fig 5 Case 10, Implantation metastases upon the cortical surface of an atrophic ovary. Detached fragments of the tumor cells

of 9 cases which Glockner (26) and Stickel (27) record, there were 5 in which neither enlarged lymph-nodes nor peritoneal implantations gave gross evidence within the abdomen of the route by which the ovaries had become invaded. In one case the only other abdominal metastases were nodes in the liver and the pouch of Douglas. Both authors seem inclined to exclude peritoneal implantation as the mode of metastasis, and fall back upon embolic transportation through the blood as the most probable explanation. Bland Sutton (25) is the only writer to refer to Handley's interpretation of the routes of extension between mammary and ovarian tumors. If we accept Handley's (34) histological findings—that a mammary cancer spreads by lymphatic permeation through the deep fascial plexus to the epigastric triangle and thus permits cancer cells easily to invade the peritoneal cavity, the theory of implantation to the organs and structures of the lower abdomen presents the same degree of probability as a frequent route of metastasis from mammary tumors as it does from carcinoma of the stomach or gall-bladder. His observations are especially suggestive regarding metastases in these organs after operations for mammary cancer—that the

modern operation protects the thoracic viscera from subsequent invasion more frequently than it does the abdominal organs.

In connection with this review of the subject of metastatic cancer of the ovaries, the writer has examined the following material

CASE 1 Embryonal carcinoma of the ovaries. Primary site, probably in ovary, rapidly growing, general metastasis of abdominal organs by invasion through peritoneal surfaces, metastases in breasts, thoracic organs apparently free from metastases.

Clinical history. A young woman had complained of a rapidly growing tumor in the right breast, which was first noted two months prior to her admission to the hospital. She had had three children and one miscarriage, which occurred two months before the tumor in the breast was first noted. Menstruation, which had last appeared five days prematurely, had otherwise been normal.

Physical examination. A large fairly well nourished woman. The right breast was enlarged to three times the size of the other. There was no superficial evidence of inflammation. The nipple was erect and protruding. In the lower outer third was a large mass, which was firm and movable over the deeper structures, and the skin was not involved. The glands in the axilla were definitely enlarged. The abdomen was flat, and a round, irregular, indefinite swelling in the right inguinal region was thought to be the distended colon. No pelvic or rectal examination was made.

Operations. A radical operation for the removal of the tumor in the right breast was performed. 14

days after which the abdomen was noted to be considerably enlarged by irregular, semi-elastic and tender tumors in both sides of the lower abdomen. An abdominal operation showed two multilocular tumors on either side of the uterus involving both tubes and ovaries, and extending to the bladder wall and superficially, to the uterine wall which was removed. The patient died 14 days after the second operation.

Autopsy. In the upper angle of the wound that was made for the removal of the right breast were two small masses. In the left breast was a rather flattened tumor, measuring 8 cm. in diameter. With the exception of adhesions between the lungs and diaphragm the thoracic cavity appeared to be normal. In the lower third of the scar in the abdominal wall were small ulcerated areas. The peritoneum appeared to be enormously thickened, white, and opaque. Old and recent adhesions were universally present and the peritoneal cavity filled with clear, yellow fluid. The pelvis appeared to be filled with tumor tissue. Both the pancreas and kidneys were studded with tumor masses, the former showing practically no normal tissue. The liver was of normal size and the markings were indistinct. The spleen was of normal size and of a dark color. The presence of retroperitoneal lymph nodes was not noted.

The tumor of the right breast. The cut section shows a peripheral layer of apparently normal breast tissue, varying in width from $\frac{1}{2}$ to 2 cm. The remainder of the breast consists of a homogeneous pale yellow mass of tumor tissue which in some places is seen to penetrate the peripheral layer of normal tissue. The histological structure of the mammary tumor consists of a diffuse mass of small or moderately sized round cells with deeply stained nuclei throughout the entire growth. There is little stroma to be seen and the signs of an alveolar arrangement are indistinct. There are scattered about in some areas fragments of a connective tissue reticulum and a fibrillary stroma can be seen now and then between apparent groups of cells but for the most part whatever suggestion there is of an alveolar formation is outlined by the grouping of the cells rather than by the arrangement of the stroma.

The ovarian tumors. The ovaries are converted into two large tumors of which the smaller one of the left ovary, measures 10 x 5 cm. and presents externally the normal ovarian shape. Its cut surface shows a pale yellow homogeneous surface. The larger tumor of the right ovary measures 14 x 8 cm. and is distinctly divided into large and small lobes which are grouped about a common center. The cut surfaces are less homogeneous than those of the left tumor and are traversed by numerous white trabeculae. The cortical area in both tumors appears to be thickened. **The histology of the ovarian tumors.** There are no traces of normal ovarian parenchyma. The tumors show a diffuse growth of small or moderately sized round cells

similar to those in the mammary tumor. Throughout a large part of the growths there is little stroma to be seen, but as the peripheral area is approached more stroma appears enclosing a few cells in such a way as to suggest an alveolar formation. Upon the external edge of the peripheral layer there is a quite distinct alveolar arrangement (Fig. 1). The cells, however, are often grouped together in the center, leaving an irregular space between the cells and the surrounding stroma. When the stroma is loosely constructed one, two, or three cells are seen within the stroma meshes. Numerous places show a long double row of cells enclosed within a fine almost fibrillary connective tissue. There are a few small vessels containing a little blood, and other small, perhaps lymphatic paths.

The metastases in other organs. The uterus which is slightly enlarged, shows an infiltration of its outer musculature with the same type of cells as those described in the mammary and ovarian tumors. The small portions of the broad ligaments that are attached to the uterus and the mesosalpinx of the right tube, are thickened by the tumor invasion. The colon shows no ulceration or involvement of the mucosa but its outer walls are uniformly thickened, presenting the same pale yellow homogeneous appearance that the tumor tissue does in the other organs. The kidneys, spleen and the liver also show a similar peripheral tumor infiltration it is especially marked in the kidneys.

We have to regard then in this case a very malignant and rapidly growing tumor, the histogenesis of which does not admit of a perfectly definite interpretation. The causal relations between the mammary and ovarian tumors are definitely certain, but the determination of the primary site is difficult. The writer has been unable to find a similar case in the literature and secondary invasion of the breasts from tumors in distantly located organs appears to be rare. From the clinical history of this case it is also difficult to decide. The tumor of the right breast evidently controlled the clinical picture before the first operation and during the following ten or more days. No pelvic examination was made during this period but from the abdominal examination made before the first operation it seems reasonable to suppose that the tumor of the right ovary at least already was present when the mammary operation was performed. The occurrence of the miscarriage two months before the mammary tumor was first noted also suggests the presence of a pelvic tumor at this time. The gross pathology of the mammary tumors suggests their

secondary nature. The histology of both the ovarian and mammary tumors admits of two interpretations. They may well be diagnosed as lymphosarcomata, but the structure of the ovarian tumors points to an epithelial origin, from which has arisen an indifferent and rapidly malignant cellular growth. The alveolar-like appearance in the peripheral areas of the ovarian tumors suggests (Fig. 1) the preservation, to a slight degree, at least, of the original type of tumor in its primary site. The route of metastasis in this case is also difficult to determine, but the absence of metastases in the thoracic viscera is suggestive, in the light of Handley's observations, of a peritoneal invasion through the abdominal wall. Upon the peritoneal surfaces no nodes of implantation were noted, but the peritoneal surfaces show a white, opaque thickening surrounding all the organs, from which, as in the liver, spleen, kidneys and uterus, are numerous irregularly shaped invasions of the tumor cells into the parenchyma of these organs. While differences of opinion in regard to the pathogenesis of this case are certainly admissible, the writer, at the suggestion of Professor Ewing, has designated the condition as a rapidly growing, embryonal type of carcinoma, in which the primary site was probably in the right ovary.

CASE 2. Recurrent carcinoma of the breast. Metastasis in the ovary by retrograde transportation through the retroperitoneal lymph nodes.

Clinical history. A single woman, 36 years of age, noted two months after an operation for carcinoma of the left breast, and six months prior to her admission to the hospital, a swelling above the left clavicle and in the left axilla. Four weeks prior to admission nodes appeared in the right side of the neck, and the masses in the left neck and axilla had grown to a large size.

The autopsy. In addition to large masses above both clavicles and in the left axilla, numerous nodes were present over the anterior chest wall, in the epigastric triangle, and over the abdominal wall, extending down to Poupart's ligament. Both pleural cavities contained bloody serum. The lungs were not involved, but large nodes filled the mediastinum, extending to the diaphragm. In the abdomen there were nodes in the portal fissure, in the spleen, along the splenic artery, throughout the mesentery, and retroperitoneal lymph nodes, extending from the diaphragm down and into the pelvis. There was a large node in the right broad

ligament. The omentum contained no metastases, and the peritoneum showed no disseminated nodes of implantation. There was one subperitoneal node upon the small intestine. The uterus and left ovary were normal.

The right ovary is of nearly normal size. Its cut-surface shows a round white node which includes about one half of its area. The histological structure of this node is that of a large alveolar carcinoma, extremely cellular and sharply defined from the other part of the ovarian structure, which shows numerous corpora fibrosa and the structure of a fairly atrophic normal ovary. No cancerous areas can be found outside the one node, even in the hilum or mesosalpinx. The structure of the cancerous node is exactly the same as that of the other abdominal metastases.

Metastasis undoubtedly occurred in this case by retrograde transportation through the extraperitoneal lymph-nodes, either by a direct extension through the posterior attachments of the diaphragm from the mediastinal lymph-nodes, or by a lymphatic extension from the nodes in the portal fissure of the liver, which became involved by a permeation of the lymphatics of the abdominal wall. Peritoneal implantation can be reasonably excluded.

Cases 3, 4, 5, and 6 were recurrent carcinomata of the breast in which there were negative findings in ovaries removed by operation.

The literature includes so many references to the possibility of the frequency of ovarian metastases in cases of primary cancer of the breast that the writer will merely report negative findings in four cases in which the Beatson operation was performed at the General Memorial Hospital, as an additional therapeutic resource to the use of the X-ray, in cases in which otherwise the prognosis seemed, undoubtedly, to be hopeless. In each instance a radical operation for the removal of the primary mammary tumor had been done. No definite conclusions, of course, are possible from a consideration of the histology of so few ovaries.

In Cases 3 and 5 the fibrosis of the cortical areas, which is consequent upon the slow resolution of the corpora lutea during the latter part of the ovary's functional activity, is so extensive as to appear to preclude the invasion of cancer cells from implantation upon their surfaces. Indentations of the germinal epithelium by reason of the atrophic changes, in some places almost reaching the medullary area, suggest themselves as favorable sites for

the implantation of cancer-cells, but, in both cases, we find in the vascular zone such advanced changes in the vessel walls — not infrequently to the extent of almost complete obliteration of the vessel lumen — that an unfavorable soil would appear to be furnished for the growth of tumor cells, whether they gained access to the ovarian structure through these fissures, or through the lymphatics of the hilum. In Case 4 the dipping of the germinal epithelium into deep crevices is most marked, and there are numerous signs of more recent junctional activity than in the ovaries of the other cases. Corpora fibrosa are to be seen less advanced, and in one ovary there is a large corpus luteum, showing only moderately advanced regression changes. A follicular cyst is also to be seen, lined by one layer of columnar epithelium, which projects upon the ovarian surface, being covered only by a thin fibrous layer. In the medullary zone also the blood vessels do not show the same changes in their walls as in Cases 3 and 5, so that the invasion and growth of tumor cells would appear to be quite possible. In Case 6 the fibrosis is well marked but the cortical surface is not convoluted as in Cases 3 and 5, and the germinal epithelium, which is well preserved in numerous places, does not dip into the ovarian stroma. There are also several follicular cysts. The changes in the vessel walls of the medullary zone are only moderately advanced.

CASE 7. Large bilateral "Krukenberg tumor" of the ovaries. Probably secondary to a gastric or intestinal growth.

Clinical history. A single woman, 28 years of age, had suffered for a long time from constipation, digestive and intestinal disturbances, which had become markedly worse during the three months prior to her admission to the hospital. She had been treated by gastric lavage by several physicians. Abdominal distention and pain in the lower abdomen had been recently especially severe. The operation for the removal of the tumors was difficult because of the presence of adhesions, but no gastro-intestinal lesion was noted. Vomiting and abdominal pains were the special clinical features until just before death, which occurred eight weeks after the operation, when intestinal hemorrhages were also noted. No autopsy was performed.

Gross pathology. Both tumors are large, the larger one, of the right ovary, measuring 12 x 15 x 5 cm, the smaller, 8 x 11 x 5 cm. The normal ovarian shape is in general preserved, but their external surfaces are bossed, particularly that of the smaller tumor, which suggests a bilobed structure. The cut surface of both tumors shows a solid structure, but not of an homogeneous consistency. There is a firm, thin capsule, within which numerous dense, but comparatively thin, trabeculae traverse the tumors in different directions, dividing the surfaces up into soft, pale yellow, or white, rather homogeneous areas of tumor tissue. In places where the tissue is soft and the spaces have more or less of a circular outline, there is a honey-combed

appearance. Small cysts are present, especially beneath the capsule. In the larger tumor there is a larger hemorrhagic cyst, and near are dark areas, evidently the result of blood extravasations.

Histology. There are no normal ovarian structures. The capsule consists of a thin, dense connective-tissue layer, in and immediately beneath which are cysts, containing no epithelial lining, some are filled with blood. The structure of both tumors appears to be fairly uniform, consisting of a fine fibrillary stroma, interlacing in all possible directions, and inclosing tumor-cells of different number, size, appearance and arrangement. Depending upon the stage of mucoid degeneration which the tumor cells have reached, they appear as round, small, with a well stained nucleus, or as moderately swollen, with a slightly transparent cell protoplasm and a nucleus pushed slightly to the side of the cell body, or, in the advanced stages, a large, swollen, and clearly transparent cell body is seen, with a nucleus pushed to the edge of the cell in the shape of a seal ring (Fig. 2). In areas where the cells are few and the degenerative changes are marked the structure has a distinctly myxomatous appearance (Fig. 3). In other areas, as along the inner border of the capsular layer, where the connective tissue is denser, one, two, or three large epithelial like cells may be seen in a single row between the stroma fibrils. Between these extrema arrangements the cells are variously grouped within the meshes of the stroma, often showing a moderately distinct alveolar form (Fig. 4). In general, the alveolar arrangement is indistinct, but the cells are apparently of epithelial origin and are distinctly separated from the connective tissue cells, which, in this case, are sparse even in the parts where the connective tissue is abundant. In some areas near the larger trabeculae, the appearance is similar to that of a scirrhous growth. In sections stained with thio saffron, the epithelial nature of the cells, as distinct from those of the stroma, is easily distinguished.

Without the evidence that an autopsy would furnish it is impossible to state definitely that the ovarian tumors in this case were secondary to some tumor of the gastro intestinal tract, but the clinical course of the disease, both before and after the operation, is suggestive that such a growth of a primary nature may have existed.

CASE 8. Histological sections of a "Krukenberg tumor."

With the naked eye the sections appear to include the greater part of an ovary enlarged to twice the normal size. The tumor growth apparently involves the entire ovarian structure, with the exception of a narrow zone of the cortical area. In places it penetrates this area to the ovarian surface, there being only a very thin layer of fibrous connective tissue on the surface.

The histology of this tumor presents the same general structure as that of the preceding case. The stroma, however, is in greater abundance and has more of a cellular character, while the tumor cells within its meshes are decidedly fewer. It is difficult to detect more than two or three of such cells grouped together. Throughout the section the outlines of the cell body are either indistinct, or they have been entirely destroyed by the mucoid degeneration so that there are often only the remains of a few scattered nuclei, making it difficult to differentiate the epithelial-like cells from those of the stroma.

CASE 9 Primary diffuse carcinoma of the stomach. Metastatic Krukenberg tumor of the ovary.

Only the sections for histological examination are available to the writer, which include a section of a diffusely infiltrating scirrhous of the stomach, a section of the mesentery and of both ovaries.

The tumor of the stomach shows a diffuse fibrous carcinoma penetrating all of the coats of the stomach wall. The section of the mesentery shows the typical structure of a Krukenberg tumor, having more of a connective-tissue stroma than the writer's Case 7, but the epithelial character of the tumor cells is more easily distinguished than in the writer's Case 8.

An apparently normal sized ovary shows about two thirds of its area to be that of normal atrophic structure. Two follicular cysts and numerous corpora fibrosa are present. The stroma does not show an abnormal cellular infiltration. Adjoining the normal area, but sharply defined, there is a nodular growth of tumor tissue, which is similar to most of the structure in the writer's Case 7, except, perhaps, the cells are less numerous. In the middle of this growth is a small normal epithelial structure, having the appearance of a graafian follicle. The tumor cells are exactly the same as those in the growth in the mesentery, both tumors being undoubtedly secondary to the growth in the stomach.

CASE 10 Primary diffuse carcinoma of the stomach. Metastatic carcinoma in atrophic ovaries. Peritoneal implantation.

The stomach, portions of the intestine and mesentery, the uterus, ovaries and tubes, with a part of the broad ligaments vesico uterine and recto uterine folds, removed at the autopsy of a woman, 65 years of age, show the following conditions. The walls of the stomach are converted throughout their entire extent into a thick, dense wall of tumor tissue. Similarly, but less so, the mesentery and intestinal wall is thickened, and over the peritoneal surfaces are scattered very small and slightly elevated nodules. The peritoneal surface of the pouch of Douglas and the vesico uterine folds are studied with similar nodules. The uterus is small, and both ovaries are markedly atrophic, having a long spindle shape.

Histology All of the layers of the stomach wall are infiltrated with a diffuse carcinoma, showing in numerous areas the structure of a fibrocarcinoma.

In the intestinal wall the growth is limited to the peritoneum and subperitoneal tissue, completely surrounding the muscularis except at the mesenteric border, where the growth follows the peritoneal layers of the mesentery, between which is a space of normal fatty tissue. A section through the bottom of the pouch of Douglas shows the same type of growth which is limited to the peritoneal and subperitoneal layers. It gives the general appearance of a fibrous thickening of the peritoneum that is infiltrated with cancer-cells. No cancerous changes are found in the tubes or uterus.

Both ovaries, which are in an advanced stage of fibrosis, show areas of early cancerous invasion which undoubtedly represent the implantation of metastatic cancer cells from the growth in the stomach. They are more advanced in the left ovary. The germinal epithelium is preserved in a few places, but in several places over the cortical zone there is a covering of tumor growth, of varying width, of the same histological structure as the growths in the stomach, intestine, and pouch of Douglas (Fig 5). In some places it is very thin, only one, two, or three rows of epithelial cells lying within a fibrillary stroma, while in other places it widens out, invading irregularly the fibrous stroma, but not infiltrating deeply the cortical zone, except in one area near the inner pole of the left ovary. A section which was made at the junction of the left uterine ligament with the ovary shows two breaks, apparently, in the peritoneal covering, by more or less wedge shaped invasions of tumor cells, beneath which are two or more small, round, isolated foci on the border between the cortical and medullary zones. There is also in the right ovary a similar small, deeply located focus near the junction of the cortex and the hilum. In the areas immediately adjoining the cancerous invasions there is no evidence of a reaction of the ovarian stroma in the form of cellular hyperplasia, but there does appear to be considerable oedematous infiltration, by reason of which the stroma is more loosely constructed, showing in a few places the suggestion of a myxomatous structure. Some of the cells in the ovarian metastases, as well as those of the other metastases and the primary growth in the stomach, are slightly vacuolated, and show considerable swelling of the protoplasm from a mucoid degeneration, so that the nuclei are slightly pushed to the sides of the cell body, but the degenerative changes are not uniformly present and have not anywhere reached the extreme stage that is so often noted in these tumors.

SUMMARY

The writer, from this review of the literature and his own personal observations, feels justified in directing attention to the following points regarding the subject of metastatic carcinoma of the ovary.

1. Malignant tumors of the ovaries, even when of such size as to control the clinical

course of the disease, are frequently enough secondary to growths in other organs, especially the stomach and the breast, as always to justify a suspicion of their secondary nature, before any method of treatment is advised, or a probable prognosis is defined.

2. The possibility of metastatic invasion of these organs should always confront the surgeon in dealing with the problem of treatment and prognosis in cases of primary growths in the stomach and breast. This is especially so in cases of recurrences in the chest wall, or in the other breast, after operations for the removal of the primary mammary tumor have been performed.

3. The route of metastasis is rarely a chance distribution by embolic transportation through the blood or lymphatic vessels, but occurs, either by a direct extension through the retroperitoneal lymph-nodes by permeation or retrograde transportation, or by peritoneal implantation.

4. Peritoneal implantation is undoubtedly a more frequent route than has previously been supposed, and next to the liver, the ovaries, especially during the period of their functional activity, are more often involved in this way than any of the other intraperitoneal organs, because of their circulatory changes, the traumatism of their surface from ovulation, and the proximity to the pouch of Douglas, which is apparently more frequently the site of peritoneal implantation of cancer cells than any of the other peritoneal surfaces.

5. The gross appearance of the ovarian tumors, when they are large and extensively involved, is not characteristic, but in the earlier stages, secondary invasions usually appear as distinct nodes, located in any area, and involving a small or a large part of the ovarian structure.

6. The histology of these tumors varies with the nature and location of the primary growth, but their morphology is undoubtedly often altered by the changed conditions of nutrition and growth which the ovarian structure offers. The adenocarcinomatous type appears to be frequent, but a larger number are of the diffuse infiltrating type, in which the glandular structure is lost, of-

ten showing a distinctly fibrocarcinomatous structure similar to the structure of the primary tumor in the stomach or breast from which they are derived.

7. The Krukenberg tumor may be a primary growth, but in the vast majority of cases it presents the histology of a secondary, diffuse, infiltrating carcinoma, which derives its features from those of a primary growth in the stomach, or from degenerative changes which are so common to all forms of ovarian growth — myxomatous degeneration, mucoid degeneration of the cells — and, frequently, from a reaction of the stroma to the invasion of cancer-cells in the form of a cellular hyperplasia.

The writer desires to express his appreciation of the numerous suggestions and criticisms which Professor Ewing has offered in the course of this study. He also desires to thank Dr. Elser and Dr. L'Esperance for much of the pathological material, and Drs. Lee and Hitzrot, of the New York Hospital, and Dr. Mallett and the House Staff of the General Memorial Hospital, for access to the clinical notes of the cases.

REFERENCES

1. ROETANSKY Lehrbuch der pathologische Anatomie.
2. BILLROTH Die Krankheiten der Brustdrüsen Deutsche Chir., 1830, xh.
3. BIRSCH HIRSCHFELD Lehrbuch der pathologische Anatomie.
4. OLSHAUSEN Krankheiten der Ovarien.
5. ZAKN Ueber einige Facille seltener Geschwulstnastasen Virchow's Arch f. path. Anat., etc., Berl., cxvii, 33.
6. LEOPOLD Ueber solide Ovarialtumoren Arch f. Gynaek., vi.
7. SCHLIEFELBUSCH Ueber multiples Auftreten primärer Carcinome Langenbeck's Arch., xxxi, 661.
8. BUCHER Casuistik und Beurtheilung primärer Carcinome Ziegler's Beitr. z. path. Anat. u. z. allg. Path., Jena, xiv, 71.
9. WALTER Ueber das multiple Auftreten primärer boesartiger Neoplasmen Langenbeck's Arch., lvi.
10. GEBHARD Pathologische Anatomie der Weiblichen Sexualorgane, 1899, 355, 363.
11. VIRCHOW Geschwülste, 4, 63, 88.
12. BOZE Zentralbl. f. Gynaek., 1895, 656.
13. FLEISCHMANN Zentralbl. f. Gynaek., 1896, 382.
14. TEMESVARY Zentralbl. f. Gynaek., 1896, 383.
15. LOVRICH Zentralbl. f. Gynaek., 1898, 626.
16. KRUKENBERG Ueber das Fibrosarcoma Ovarii mucocellulare (carcinomatodes) Arch. f. Gynaek., 1, 287.
17. SCHLAGENBAUER Ueber das metastatische Ovarialcarcinom nach Krebs des Magens, Darmes, und anderer Bauchorgane Monatschr. f. Geburtsh. u. Gynaek., xv, 485.

- 18 GLOCKNER (26), 7, STICKEL (27), 9, ENGELHORN (28), 13, WAGNER (37), 1, ROEMER (49), 2, FAURRISE AND HEVILLY (Zentralbl. f. Gynaek., 1913, 1259), 3, AMANN, 6, also (Zentralbl. f. Gynaek., 1909, 482), 1, COHN (44), 2, HUSSY (Hegar's Beitr. z. Geburtsh. u. Gynaek., xvi, 487), 1, SNOO (Zentralbl. f. Gynaek., 1907, 1446), BRUNNER (Zentralbl. f. Gynaek., 1907, 1606), 1, SANTSCHENKO (Zentralbl. f. Gynaek., 1908, 413), 2, GOULLIHOOD (30), 5, BIERCHER (Zentralbl. f. Gynaek., 1908, 10), 1, OBERDORFER (Zentralbl. f. Gynaek., 1910, 1), PERKIN (Zentralbl. f. Gynaek., 1912, 787), 1, ULESKO-STROGANOFF (38), 3, LAMPARTER (Zentralbl. f. Gynaek., 1904, 148), 5, BLAND SUTTON (25), 2, WEYL (Zentralbl. f. Gynaek., 1906, 1054), 1, OMORI (Zentralbl. f. Gynaek., 1906, 220), KUTSER (50), 1, TIBERTIUS (Zentralbl. f. Gynaek., 1900, 679), 2, ZITZENFREY AND SCHENK (57), 3, ZITZENFREY (59), 2, SCHAUTA (Zentralbl. f. Gynaek., 1907, 112), 1, GEIPEL (Zentralbl. f. Gynaek., 1906, 958), 1, STERNBERG (Zentralbl. f. Gynaek., 1906, 706), 1
- 19 GLOCKNER (26), 6, STICKEL (27), 3, ZITZENFREY (35), 1, HALLAUER (Zentralbl. f. Gynaek., 1909, 61), 2, SCHMIDKE (Zentralbl. f. Gynaek., 1914, 484), 2, BRENNINCKE (Zentralbl. f. Gynaek., 1905, 1506), 3, CHARI (Prag med. Wchnschr., 1905, 229), 1, OSTERLOH (Zentralbl. f. Gynaek., 1904, 584), 1, GROTE (Zentralbl. f. Gynaek., 1911, 710), 2, STORZ-NEGGER (cited by Bucher, 8), 2, AMANN (29), 2, BRIGGS (J. Obst. & Gynaec., Brit. Emp., xii, 77), 2, BLAND SUTTON (25), 1
- 20 GOULLIHOOD (Zentralbl. f. Gynaek., 1905, 1911), 1, WALL (Zentralbl. f. Gynaek., 1914), 1, BONDY (Zentralbl. f. Gynaek., 1914, 375), 1, SCHMIDKE (Zentralbl. f. Gynaek., 1914, 484), 1, BRUNNER (Zentralbl. f. Gynaek., 1907, 1606), 1, SANTSCHENKO (Zentralbl. f. Gynaek., 1908, 413), 1, KOUWER (Zentralbl. f. Gynaek., 1908, 840), 2, GLOCKNER (26), 2, STICKEL (27), 1, BLAND SUTTON (25), 5, AMANN (Zentralbl. f. Gynaek., 1908), 1, BRIGGS (J. Obst. & Gynaec., Brit. Emp., xii, 77), 4, LOV- RICH (15), 1
- 21 AMANN (Zentralbl. f. Gynaek., 1912, 1224), 1, TILP (63), 1, KAMANN (Zentralbl. f. Gynaek., 1906, 1015), 1, SCHMIDKE (Zentralbl. f. Gynaek., 1914, 484), 1, GOULLIHOOD (30), 1
- 22 WEIBEL (Ztschr. f. Geburts. u. Gynaek., 628), 1, BLAND SUTTON, 2, SAUTER (Zentralbl. f. Gynaek., 1914, 484), 1 case
- 23 FAIRRISE AND HEVILLY Zentralbl. f. Gynaek., 1913, 1259, 1 case
- 24 AMANN Zentralbl. f. Gynaek., 1910, 1635, 1 case
- 25 BLAND SUTTON Brit. M. J., 1906, 4, 1210, 1908, 4, 5
- 26 GLOCKNER Arch. f. Gynaek., lxxii, 410
- 27 STICKEL Arch. f. Gynaek., lxxix, 605
- 28 ENGELHORN Gleichzeitiges Vorkommen von malignen Ovarialtumoren und Magentumoren Hegar's Beitr. z. Geburtsh. u. Gynaek., xi, 289
- 29 AMANN Ueber sekundäre Ovarialtumoren Muenchen med. Wchnschr., 1905, lii, 2415
- 30 GOULLIHOOD Rev. de gynéc. xi, 394
- 31 PFANNSTIEL Veit's Handbuch der Gynaek., 1908, iv, 187
- 32 COUPLAND Tr. Path. Soc., London, 1876, xxvii
- 33 TOEKER AND WITTELHOEFFER Zur Statistik der Mamma Carcinome Arch. f. klin. Chir., xxv, 873
- 34 HANDLEY. Dissemination in cancer of the breast. Lancet, Lond., 1905, April 15, Brit. M. J., 1909, March 6
- 35 SEITZENFREY Mammakarzinom zwei Jahre nach abdominaler Radikaloperation wegen doppelseitigem Carcinoma Ovarii Prag med. Wchnschr., 1907, No. 18 and 19
- 36 FLEW Berl. klin. Wchnschr., xlix, 833.
- 37 WAGNER Zur Histogenese der sogenannten Krukenberg'schen Ovarialtumoren. Wien. klin. Wchnschr., xv, 519
- 38 ULESKO-STROGANOFF Zur Histogenese der sogenannten Krukenberg'schen Eierstockgeschwulste Zentralbl. f. Gynaek., 1910, 1040
- 39 SCHENK Ztschr. f. Geburtsh. u. Gynaek., li, 277.
- 40 WERMUTH Ueber Ovarialsarkome, ihre Vorkommen und ihre Complicationen Ztschr. f. Geburtsh. u. Gynaek., lvi, 123
- 41 GLOCKNER Arch. f. Gynaek., lxxv, 49
- 42 BONDY Zentralbl. f. Gynaek., 1914, 375.
- 43 FISCHER Zentralbl. f. Gynaek., 1910, 621.
- 44 COHN Zentralbl. f. Gynaek., 1908, 714
- 45 SCHWARZ Am. J. Obst., lvi, 752
- 46 OUTERBRIDGE "Krukenberg" tumor of the ovary. Am. J. Obst., 1911, lxi, 925
- 47 KRAUS Ueber das Zustandekommen der Krebsmetastasen in Ovarium bei primärem Krebs eines anderen Bauchorganes Monatschr. f. Geburtsh. u. Gynaek., xiv
- 48 POLANO Experimentelle Untersuchungen ueber die Durchlässigkeit des Eierstockepithels fuer corpusculäre Elemente Zentralbl. f. Gynaek., 1907, 784
- 49 ROEMER Ueber scheinbar primäre, in Wirklichkeit metastatische Krebserkrankung der inneren Geschlechtsorgane bei Tumorbildung in Abdominalorganen Arch. f. Gynaek., 124
- 50 KUTSER Zur Histologie der metastatischen Ovarialkarzinome Ztschr. f. Geburtsh. u. Gynaek., lxxvii, 364
- 51 REBERT Geschwulstlehre, 482
- 52 BOST Die Lehre von den Geschwulsten, 50
- 53 GOODALL The origin of epithelial new-growths of the ovary. Tr. Am. Gynec. Soc., 1911, xxxvi, 567
- 54 WALTHARD Ztschr. f. Geburtsh. u. Gynaek., xlix
- 55 SCHAEFFER, Primäres oder Metastatisches Ovarialcarcinom Mittl. a. d. Grenz d. Med. u. Chir., 1912, xiv, 379
- 56 WOLFFHEIM Experimentelle Untersuchungen ueber die Durchlässigkeit des Keimepithels fuer corpusculäre Elemente und Bakterien Monatschr. f. Geburtsh. u. Gynaek., 1906, xxvi, 63
- 57 ZITZENFREY AND SCHENK Gleichzeitiges Karzinom des Magens, der Ovarien und des Uterus, mit besonderer Berücksichtigung ihrer operativen Behandlung und ihrer histologischen Befunde. Ztschr. f. Geburtsh. u. Gynaek., li, 392.
- 58 GOTTSCHALK Cited by Glockner
- 59 ZITZENFREY Ueber lediglich macroscopisch nachweisbare metastatische Carcinomkrankung der Ovarien bei primärem Magencarcinom Mittl. a. d. Grenz d. Med. u. Chir., 1909, xii, 372
- 60 SCHNITZLER Ueber eine typische lokalisierte Metastase des Magencarcinoms Mittl. a. d. Grenz d. Med. u. Chir., xi, 113
- 61 ROSENSTEIN Surg., Gynec. & Obst., 1910, xi, 113.
- 62 STRAUSS Ueber Eileit. in Magen Berl. klin. Wchnschr., 1899, xxxvi, 870
- 63 TILP Berl. klin. Wchnschr., 1908, xlv, 1180

ANTERIOR TRANSPERITONEAL HYSTEROTOMY¹

By JOHN B. DEEVER, M.D., F.A.C.S., PHILADELPHIA

IN surgical diseases it has been proved by modern surgical methods that the best way to attack a pathological condition or unfold a puzzling symptom-complex is to expose the afflicted parts to the light of day and to the eye of the surgeon. By so doing a fuller comprehension of the living pathology present may be gained, the greatest relief obtained with the least sacrifice of function and tissue, and a guarantee against future complications afforded.

One by one the cavities of the body have yielded to the surgeon. The treatment of hidden surgical diseases has improved in direct ratio with the boldness of exposure and directness of attack. We are sure that uterine disease also will be better treated when many of the present blind methods of diagnosis and treatment have given way to direct inspection and treatment under the guidance of the eye.

In advocating the operation of hysterotomy I bear in mind the fact that I have been doing it for years with no mortality and with the satisfaction of knowing that certain obscure conditions have been found and eliminated by early and radical means, which, by the more conservative methods now in vogue would have failed both of early diagnosis and proper treatment. I firmly believe that the early diagnosis and cure of malignant changes of the fundus can be made best by hysterotomy and that the large maternal mortality in placenta prævia can be reduced almost to nothing by this operation, while the foetal mortality will be greatly improved. In addition to these clean cut indications for hysterotomy the procedure will be found most useful in clearing up the exact condition in many cases now beyond our diagnostic powers, and in this way the seemingly radical proposal will result in the most conservative surgery adapted to the individual case.

The operation is not new in the history of medicine, having been performed many times in the past but at first, only as a terminal procedure on dead or dying mothers in the

hope of obtaining a living child. Later it was used in the attempt to save both mother and child after many vain attempts to deliver *per vaginam*, and, lacking the modern safeguard of asepsis, produced a frightful mortality.

Hysterotomy prior to the seventeenth century has no practical interest although the first recorded case in which the operation was done on a living woman was in 1500 by Jacob Unfell, a butcher, who saved his wife and later is reported to have operated on several other women with success. In 1610 the well authenticated case of hysterotomy by Trautman in Germany is recorded; but up to 1893 only 37 to 40 per cent resulted in recovery.

Blensell, in 1834, reported 23 cases, the only ones in England before 1827, all of whom died except one. For a period of twenty years in Paris there was not a single recovery from this operation. From 1891 to 1896 the mortality was 38 per cent, in 1902, 20 per cent; and it was further reduced in 1904 to 12 per cent.

The operation of hysterotomy or cesarian section has always been saved as a last resort, and the crude efforts of our ancestors to avoid the peritoneum in its performance explain this great mortality.

The operation until recently has been exclusively in the hands of the obstetricians, and only obstetrical conditions have justified in their minds its performance, but obstetrics is notably conservative, as was gynecology until a few years ago. While natural methods are always preferable, it must be granted that in the presence of pathological conditions it is not wise to rely upon them until the patient has been exhausted or her tissues torn and lacerated by methods directed from below, with the result that when hysterotomy is finally done life is sacrificed by watchful waiting and the mortality advances to the point that condemns the procedure.

Especially does this obtain in placenta

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prævia, for which obstetricians still claim that version is the operation of choice. In the last analysis, however, any procedure must stand or fall upon its mortality and unless the obstetrician can show that his methods are equal or superior in their results to hysterotomy he must yield.

It is conceded by everyone that certain degrees of contraction of the pelvis are indications for hysterotomy, but I believe and advocate its performance in placenta prævia, premature separation of the placenta, severe toxæmia of pregnancy and eclampsia, in some cases of pyelitis of pregnancy with marked septic symptoms, in certain cases of submucous fibroids, in cases of unexplained uterine bleeding in middle aged females at or near the cancerous age, and in cases of prolapse of the cord with a living child and a rigid and non dilatable cervix.

In advocating such a wide performance of this operation I suggest that certain rules of technique be followed:

1. Rigid asepsis
2. Careful delivery and walling off of the uterus from the general peritoneal cavity
3. Early operation before manipulation from below has sapped the patient's strength and introduced infection
4. Careful closing of the uterine wall

The operation is simple easily carried out relatively free from risk, obviates vaginal or perineal lacerations and recovery is rapid. There is, in cases at term, no pain of prolonged labor and the fetal mortality is low.

In the past five years I have performed hysterotomy in 64 cases. The general indications for its performance have remained as stated by me in my last paper in June 1914: (1) to establish a prompt and certain diagnosis when a reasonable suspicion exists of malignant disease of the interior of the uterus, (2) to terminate pregnancy promptly in cases in which life is acutely endangered by the continuance of that condition.

The pathological conditions found were as follows:

Simple myoma of pregnant uterus	1
Symmetrical myomatous enlargement of uterus	8
Retained products of conception causing suspicion of malignant disease	10

Premature separation of placenta, suspected of placenta prævia	10
Chorio-epithelioma	1
Early carcinoma of fundus	1
Chronic hyperplastic endometritis	6
Benign polyp of the endometrium	3
Contracted pelvis (fœtus at term)	1
Toxæmia of pregnancy	1
Toxæmia of pregnancy and eclampsia	2
Placenta prævia	10
Septic pyelitis	5
Dead fœtus in tuberculous mother	1
	64

There was no maternal mortality in the pregnant cases. Three children lived, the remainder all being under six months and non viable. The average stay in the hospital of all cases was 19.7 days, and convalescence was uneventful, only 2 had post-operative pain, 4 bled slightly from the cervix, 29 had no pain the first night, and 2 had slight skin infections.

The average number of children born to these patients was 4. Miscarriages and previous difficult labors were found sporadically in the series, but had no statistical value.

Except for those outspoken cases of pregnancy in which the operation was dictated by the necessity of prompt and thorough evacuation of the uterus, these cases were characterized chiefly by the lack of symptoms that would enable a diagnosis to be made by any other means than that employed.

Those cases of pregnancy accompanied by pathological lesions had a duration of only 3.9 months, and as the lesion was sufficient to have caused risk of life to the mother termination at this time was justifiable.

Of the above cases, placenta prævia seems to invite most discussion as to the propriety of doing hysterotomy or version. McDonald, reporting the results in 8,625 cases, shows a maternal mortality in all cases of 7.22 per cent and a fetal mortality of 55 per cent, in central placenta prævia a maternal mortality of 15 per cent and a fetal mortality of 77 per cent, and in marginal placenta prævia a maternal mortality of 4.8 per cent and a fetal death rate of 58 per cent.

The great danger following a natural delivery in placenta prævia is the post partum hæmorrhage, occurring as it does in a patient already sadly depleted by bleeding. Those who have delivered cases by the abdominal

method are impressed with the great control of hæmorrhage by the operator and its immediate cessation in comparison to the vaginal method.

I have 10 cases in this series of placenta prævia on which a hysterotomy was done. The maternal mortality was nil, the foetal mortality was 43 per cent, due to the fact that cases were usually bleeding profusely when admitted to the hospital and were in the early stages of pregnancy before a viable child could be delivered and survive. The average length of the duration of pregnancy at the time of operation was 4.7 months, the longest being 8.5 and the shortest 3 months; one at full term done nine years ago has a perfectly healthy child now living. The average number of days spent in the hospital was 17; longest 28 days and the shortest 11 days.

All cases had uneventful recoveries, none having post operative pain or fever.

Eclampsia, another indication to my mind for hysterotomy, is an auto intoxication owing its origin to the pregnant state, and, although we must admit ignorance of its true etiology, we do know that throughout the course of the disease there is a profound disturbance of metabolism. There is no specific therapy, and the only rational cure for this intoxication is to remove the cause. Palliative measures should be used at first, but they should not be carried to the point of exhausting the patient or allowing her to become a poor surgical risk by the weakening effect of frequent convulsions.

According to Peterson the mortality of eclampsia increases with the number of convulsions and manipulations from below preceding operation.

Number of Convulsions	Cases	Deaths	Mortality per cent
1 to 5	237	44	18.5
6 to 10	129	26	20.1
11 to 15	37	10	27
16 to 20	16	6	37.5
21 to 23	8	4	50
26 to 40	6	5	83.3
60 to 64	2	2	100

Lupman reports from the clinics of Wurtzburg, Basel, Halle, and Berlin a mortality of

23 to 30 per cent, by expectant treatment, and 2.8 per cent or even 1.8 per cent after immediate operative delivery. Zweifel reports an expectant mortality of 28.5, operative 11.25 per cent. Baum and Ferie of Milan report an expectant mortality of 30 per cent with an operative mortality of 2.3 per cent and 7 per cent respectively. Peterson, out of 290 cases spontaneously delivered, reports a maternal mortality of 18.96 per cent and an operative mortality of 14.96 per cent. The German statistics show an expectant mortality in 390 cases of 28.9 per cent, and an operative mortality in 615 cases of 15.9 per cent. Kroenig and Sellheim have 26 cases all mothers and children recovering after this operation.

While such figures do not mean that every woman with antepartum symptoms of eclampsia should be subjected to the operation of hysterotomy, they do mean that we should revise our opinion regarding the status of this operation when indicated.

Manual and instrumental dilatation of the cervix is attended with grave immediate and remote dangers, it aggravates the eclamptic seizures causing shock and deep cervical tears, hæmorrhage, and infection, while in hysterotomy you have a clean cut tissue rather than a divided one less shock, less danger of infection, and at all times you are master of the situation.

One of the abnormalities of childbirth producing a large maternal and foetal mortality, is premature separation of the placenta with concealed or accidental hæmorrhage. Everyone has met with cases of this dangerous complication of labor when an inert uterus is distended with blood complicated by a further post-partum hæmorrhage after delivery. These cases must, of course, be packed, which gives rise to infection in a large percentage of cases. When the uterus is tense and tender and cannot be made to contract and the concealed hæmorrhage is increasing the patient becoming more collapsed, abdominal hysterotomy is indicated because it is quickly performed and hæmorrhage, if it occurs, is under the eye. There were 10 cases of this complication in our series. The average stay in the hospital,

was sixteen days; all the mothers recovered and left the hospital in good condition.

In 7 cases an hysterotomy and appendectomy were performed; in three, simple hysterotomy.

The symptoms complained of were variable; 5 had pain in the lower abdomen, 1 in the back, and 2 had no pain at all.

Hæmorrhage was severe in 6 and slight in 3 cases, the duration of the hæmorrhage averaging seven weeks. The menstrual history was not conclusive. Seven had borne children, 2 were primiparæ. The abdominal examination showed nothing but tenderness in the lower quadrants and about McBurney's point. The vaginal examination showed vaginal bleeding in only 2 cases.

The operative findings showed degenerated placenta in 5 cases, partially separated placentas in 4, and entirely separated in 3 cases. The fœtus were all dead, the course of pregnancy having continued for an average of only four months and but 1 being over five months. All recovered, 1 was slightly shocked after operation and 2 had a slight wound infection.

In 5 cases hysterotomy was done because of severe renal infection during pregnancy, amounting almost to sepsis.

Simple pyelitis is not an indication for hysterotomy, local and medical palliative methods should first be tried in all cases and usually will affect a cure, but when, after having tried the above, the septic condition increases, evacuation of the uterus by the transperitoneal route is advised. When patients are able to command facilities for medical treatment they should be allowed to continue to term if possible, but in hospital practice this is not always possible. A parturient woman with an active infective process is in great danger of post puerperal sepsis and the life of the mother in this class of cases is the paramount consideration. It must be emphasized that renal infection *per se* in the pregnant woman is not an indication for this operation, which must be reserved for those desperate cases in which prompt action is needed to save life.

The operation performed in these cases was simple hysterotomy and delivery in 3

cases; hysterotomy, delivery, and appendectomy in 2. The average stay in the hospital was sixteen days, all mothers recovering and leaving in much better condition than on entry.

Twenty-one cases were operated on because of bleeding which aroused suspicion of malignant disease of the interior of the uterus. Ten of these cases showed retained products of conception. I would naturally wish to avoid hysterotomy in these cases but the circumstances were such that pregnancy did not seem a probable explanation of the symptoms. Such errors are possible under this method of procedure, but in extenuation it may be said that not one received any apparent harm from the operation and departed cured. Of the remaining cases there were 5 that in my mind, justified the procedure, since malignant disease was discovered in 2 and benign polyp of the endometrium in 3. One case showed an early chorio-epithelioma and has remained well since hysterectomy. Another showed a very early carcinoma of the left cornu and likewise has remained well after removal. The 3 cases of polyp were readily rid of this pathological condition without removing the uterus. These cases were particularly satisfying as it has happened to me on a number of occasions to fail to remove such polyp by scraping, causing a diagnosis of essential hæmorrhage or malignancy with summary removal of the uterus only to find a simple condition easily remediable by hysterotomy.

The majority of these cases had been curetted one or more times without relief prior to the operation. I do not advocate hysterotomy when one curettage has afforded some relief; but the inadequacy of the curette is demonstrated on opening the uterus after its use and the histories of many patients are the histories of many such scrapings with no relief.

Blind scraping of the inside through the cervix with a sharp curette is one of the most pernicious practices in medicine. It is done on the slightest excuse, and the result is that the endometrium, glands, and all functioning tissue are removed with no relief of the trouble, and often there result in addition menstrual disturbance and sterility. Those

cases in which the uterus was opened and no further pathology found than a chronic hypertrophic endometritis were curetted through the opening in full sight, which could be done gently and effectively.

In 2 cases myoma was found complicating pregnancy, the fetus was sacrificed, the myoma removed, but the uterus was saved for future pregnancies.

Another type of myoma in which hysterotomy is of value is that which produces a symmetrical enlargement of the uterus indistinguishable to sight and touch from normal pregnancy. I can agree with Maurice Richardson when he said that he could not always tell a pregnant uterus when he had it in his hand. Every operator of experience has met with cases presumably of tumor in which after opening the abdomen he is disconcerted by the great resemblance to pregnancy. I have closed the abdomen in such cases only to be compelled to operate after an interval had proved that the condition was really tumor and not pregnancy. In eight cases I have applied the crucial test of incision rather than risk removal of a uterus which was possibly pregnant and in all verified the diagnosis of myoma before proceeding further.

These classes of cases are the ones that involve difficult problems of diagnosis and treatment and have led me to advocate this operation. I acknowledge that at times conditions are found which could be relieved from below, but the lack of danger in performance of this operation, the satisfaction of seeing your field and exploring it thoroughly before closing, and of being able to find or eliminate early carcinoma with reasonable certainty, outweigh all arguments of excessive surgery.

There is no danger in future pregnancies if you cut well and sew well using absorbable sutures and putting the sutures down to, but not through, the endometrium. In experiments on guinea pigs carried on at the Lying in Hospital in New York, it was found that, after opening and carefully suturing the uterus, the scar was very difficult to find on microscopic examination.

When non absorbable sutures are used, or

when the uterine incision becomes infected a stretching of the scar sometimes results, but there are only 26 cases on record out of the many hysterotomies done in which a uterine scar has ruptured in a subsequent pregnancy.

The operation of extraperitoneal hysterotomy has gained wide popularity with some operators. It was revived in 1906 by Frank, having been attempted in the earlier days of abdominal surgery when sepsis was unknown, in the effort to avoid opening the general abdominal cavity.

The operation is a suprasymphysal section of the lower uterine segment under the anterior reduplication of peritoneum. There are in all sixteen techniques with a 6 per cent maternal mortality.

The method now used is not strictly an extraperitoneal section as the peritoneum is opened. It is performed in the following manner, a paramedian, median, or Pfannenstiel incision is made through skin and fascia, the parietal peritoneum is exposed and opened in a straight line parallel to the long axis of the body, the uterine reduplication of peritoneum is also opened and either sutured or clamped to the cut edges of the parietal layer, the uterus is opened and the child delivered, and the peritoneum is now resutured to its original layer.

This operation was vaunted in infected cases but having proved a failure in these was advocated in clean cases as more efficient than the classical method.

The objections to this procedure are many. In the first place stitching the peritoneum in virulently infected cases does not make it germ-proof, for the peritoneum after being separated laterally from the uterus is lacerated and lowered in vitality and is more quickly infected, there is, especially in early labor, insufficient space for the uterine incision, there is danger of bladder injury and the head must be pried out of the uterus or dragged out with forceps which is more likely to cause injury or death of the child. It is admitted by its advocates to be a much more difficult and dangerous operation than the classical one and has no special advantages.

The vaginal method of hysterotomy is used extensively abroad and is only applicable

in obstetrical conditions and even then has many drawbacks. It is more difficult to perform, there is always a danger of injuring the bladder, the cervix is hard to draw down, there is difficulty in suturing accurately in a narrow pelvis, and there is a very poor exposure of the interior of the uterus.

Finally, I claim the operation of anterior

transperitoneal hysterotomy is a most valuable addition to the general surgeon in the course of his pelvic work; it gives him a method of making a diagnosis in early malignancy and saving life in many dangerous complications of pregnancy. It is easy, simple, and safe. Its success depends on the early recognition of the necessity of doing it.

THE ROENTGEN TREATMENT OF UTERINE CARCINOMA¹

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IT has been suggested that in this evening's discussion you will be more interested in a practical summary of the roentgen treatment of uterine carcinoma, dealing with results and present technique, than in a dissertation upon the histological, theoretical, and experimental data upon which our present knowledge of the subject is based. Assuming that you will all agree with me that purely superficial cervical epithelioma responds successfully to properly applied roentgentherapy, I will confine my remarks to an inquiry into the value of present-day deep roentgentherapy in uterine cancer which has advanced beyond the stage of the superficial epithelioma.

It needed but a short while after Roentgen's discovery to develop a technique for the successful treatment of superficial cancer by means of the X-rays, but nearly ten years elapsed before means were found for filtering out the softer and less penetrating rays which are active in producing roentgen dermatitis. The earlier experiments seemed to indicate that the X-rays were not satisfactory in the treatment of deeply seated lesions, but the introduction of some newer methods to be described shortly brought about a reversal of the opinion founded on the first results.

There have been a number of new developments in roentgenology, both in the production of more powerful apparatus and in the refinement of therapeutic methods, making possible more accurate estimation of the dosage. Nearly two years ago Coolidge announced the invention of a new X-ray tube which has

proved to be a powerful and very precise instrument. New and powerful sources of high tension current have been devised. The technique of irradiation has been much improved by the adoption of cross-fire methods and the practice of filtration. It is no longer considered necessary to place the X-ray tube at a great distance from the skin; for, inasmuch as the intensity of the X-rays varies inversely with the square of the distance of the anode from the part under fire, it is evident that when a tube is brought nearer to the skin, the time required for a certain dosage to a deep-lying structure will be proportionately diminished. The former objection to the short focus skin distance was the much greater danger of injury to the skin. Since the introduction of filtration methods, however, this danger of skin injury is eliminated to a considerable degree, and it is now possible to bring the tube much closer to the skin, thus materially shortening the time required to administer an effective dose.

These various developments have rendered possible the practical employment of effective doses of roentgen rays aggregating at least one hundred times the maximum dose considered safe ten years ago. A number of benign deep seated affections which hitherto have responded only uncertainly to the efforts of roentgenologists now offer some of the most successful fields for deep roentgentherapy. This increasing success with benign lesions has aroused hope that by applying to malignancies the same improvements in technique

¹ Presented in the symposium on Cancer of the Uterus at the meeting of the Chicago Gynecological Society December 17, 1925 (for discussion see p. 502)

and increased dosage, we might at last find in the rays a really curative agent.

It is only proper to add the warning that this advance has been accompanied by a corresponding increase in the danger attending the unskilled application of this potent means. Hence, far greater skill and judgment is required for the successful and safe administration of deep roentgentherapy in the present understanding of the term. Not the least of the dangers involved in the present-day methods is the likelihood of giving inadequate treatment. Insufficient irradiation is likely to produce more active growth through irritation instead of the intended destruction, thus tending to render inoperable, tumors which might have been operable, and increasing the likelihood of metastasis. Without adequate filtration, the action of the X-rays, as well as that of radioactive substances, is far too intense at and in the neighborhood of the point of entrance, and far too weak a short distance away. With the recent improvements in roentgen technique, these disadvantages are, to a considerable degree, eliminated, for the roentgen tube furnishes many thousand times more rays than the available quantity of radioactive substances, and hence can be applied from a greater distance. Malignant tumors belong to a class of lesions in which treatments should be given in distinctly massive doses, and any treatment with radioactive substances which does not produce improvement is likely to cause considerable injury.

Several years were consumed in the development of these more powerful apparatus, special tubes, and improved methods. During this time numerous papers have appeared by foreign and American authors. In this country, G. E. Pfahler has taken the lead in papers dealing with the roentgen treatment of malignancies and his results seem to be the most promising. The earlier papers, which are the ones referred to in most textbooks at the present time available, dealt with cases treated by the old, inadequate methods. Hence in reaching a decision as to the present value of the roentgen method, our minds must be open to conclusions drawn from recent experimentation and the results of

treatments given by the improved technique above outlined.

Attention should be called to the fact that radium- and roentgentherapy are very closely related to each other, both as to theory of effect and principles of application. In some respects it would have been more satisfactory to discuss these two subjects under one head, for certainly the most successful method of applying radiotherapy at the present time is by the combined employment of radium and roentgen rays, the radium (or mesothorium) internally and the roentgen rays externally. As will doubtless be emphasized by another speaker, in radiumtherapy we wish to utilize the γ rays, and therefore filter out the rays of lesser penetration. In deep roentgentherapy the effort has been to utilize as hard rays as could possibly be obtained. The Coolidge tube is now available for the continuous application of hard roentgen rays with a penetration approximating that of the lower γ rays of radium, and there is promise of still further development of its possibilities both through increasing the penetrating power and by greatly increasing the quantity of rays which may be administered within a given time. Through the first Coolidge tubes which were kindly supplied me by Dr. Coolidge some months before they were placed upon the market, we were able to send from five to ten milliamperes of current for hours at a time at a voltage represented by an equivalent spark gap of ten inches. There is practically no limit to which the penetration of the rays from a Coolidge tube can be raised. This penetration is not measurable with the Bauer qualimeter, or with any other penetrometer now available. With the old tubes, especially when cooling with ice-water, we were usually able to reach a penetration as high as 10 Bauer and to maintain a current of four to six milliamperes continuously. The later developments in the work of Dr. Coolidge have shown the feasibility of placing at the disposal of physicians a tube backing up a parallel spark gap of fifteen inches with rays of such penetration that ten millimeters of aluminum will be required for protecting the skin instead of the three or four millimeters

now ordinarily used. In fact, such tubes are already available, with almost unlimited capacity for milliamperage (up to 100 milliamperes) and for continuous running at this great intensity.

It should further be noted that the study of histological specimens shows that there is no essential difference between the biological effects produced by the roentgen rays and by the rays of radium or mesothorium. The effects of the roentgen rays upon mouse carcinoma, as described by Contani, and independently by Wedd and Russ, agree very accurately with the histological findings after radium treatment of mouse carcinoma, as described by Apolant, Bashford, Murray and Cramer, and Wedd, Chambers and Russ. The roentgen rays brought about the same histological changes in sarcomatous growths (Clunet and Raulot-Lal'pointe) as were observed in a fibrosarcoma exposed to the γ rays of radium (Dominici). In view of the fact that these conclusions have been reached independently by various observers, there is no great likelihood that the findings have been incorrectly interpreted.

Therefore the discussion of radium and roentgen rays should rightly have been included under one head, for with both agents the biological effects as well as the principles of application, including means of filtration, cross-fire, protection of patient and of operator, are practically identical. There are many who dissent from this opinion, holding that the radium or mesothorium treatment of deep-seated malignancy has a great many advantages over the roentgen method. Such opinions are probably biased, doubtless honestly, by the possession of more or less radium or mesothorium which must be made to "work." On the other hand, there are some who believe the comparison all in favor of the X rays. Bumm in particular states from his experience of two years at the Berlin Clinic for Women that in the treatment of carcinoma, it is not possible to go deeper than two, or at the most, three centimeters with the radio active substances without injuring the surrounding tissue. If the carcinomatous proliferations are superficial, they undergo a prompt and apparently permanent cure

But if in advanced cases, infiltration has developed in the neighborhood of the primary focus, the superficial lesions will promptly heal, nevertheless underneath the callous scar, the carcinoma will continue to grow and after six months or a year the patient will return with a cured primary focus, without secretion or hemorrhage, but with fresh nodules grown in the deeper tissues. Attempts have been made to deepen the effect of radioactive substances by the administration of larger doses, but in a large measure unsuccessfully, because the superficial tissues situated within the zone of intense radiation suffer considerable injury in spite of all filtering, as soon as a depth of three, four, or more, centimeters has been reached. This leads to necrosis and although the patient may be clinically cured of cancer, the untoward effects from mesothorium and radium burns may lead to the patient's death. With the roentgen rays Bumm holds that they can be applied at a greater distance from the tissues and in this way the superficial layers will no longer show considerable injury, while a sufficiently strong effect is obtained in the deeper parts.

It has never been demonstrated that the effect of γ -rays on carcinomatous tissue is more intense than hard roentgen rays. In the treatment of cancer, the effect depends upon the quantity of rays absorbed by the pathological tissue, and the degree of success will improve just so far as the absorption of rays in the carcinomatous tissue can be increased. By the application of exceedingly large doses, and the use of ultrahard rays, it is now possible to obtain such brilliant results in the treatment of deep seated tumors as have never before been hoped in the history of roentgentherapy. For the present, it must be admitted that these results are only palliative. A sufficient percentage of apparent cures lasting three or more years has not yet been obtained, so that at the present time we are not justified in claiming for the X-rays (or for radium, either, for that matter) a curative value.

Reference has already been made to the necessity of avoiding inadequate treatment. Experimental studies have shown that a small

amount of roentgen or radium rays has a stimulating action on tumors. One of the greatest dangers of radiotherapy, therefore, is that the dose given at the surface may destroy or injure the tissues making up the superficial layers, while the much smaller amount that reaches the deeper tissues may have only a stimulating action. Thus it is conceivable (and indeed a well-known fact) that the superficial layers of a malignant tumor may be destroyed while the growth of the deeper layers is aggravated. This effect is explained by two facts: (1) The intensity of the rays increases with the square of the distance; (2) a part of the rays are absorbed by the tissues through which they pass. Keetman's experiments show that 30 per cent of the roentgen rays are absorbed in each centimeter of tissue. Bumm claims that the destructive action of the γ -rays of radium is exhausted at three to four centimeters from the surface. As von Franqué has put it, it is not easy to steer between the Scylla of "too little" and the Charybdis of "too much."

Unfortunately the roentgen rays are not selective in the sense that they destroy only carcinomatous tissue and do not effect the normal tissue. It is true there is a certain intensity at which they can act on the different tissues tending to destroy carcinomatous cells, stimulating the growth of connective tissue around the carcinomatous tissue, and acting in a neutral manner upon other normal cells, such as epithelium. If the ray intensity is given in less than this strength, the carcinoma may even be stimulated to greater, more active proliferation. If the ray intensity is excessive, even the neighboring tissues may be destroyed. This is not only true of the roentgen ray, but also of the γ -rays of radium.

Carcinomatous tissues are quite sensitive to the X-rays. This sensitiveness, except in certain locations, is greater than the sensitiveness of the surrounding tissues. Histologically it has been demonstrated that, under ray treatment, degeneration of malignant cells may take place before any effect upon healthy cells is demonstrable. The nearer the malignant cells approach the embryonal type of tissue, the greater their radiosusceptibility,

the younger pathological cells are effected by rays which have passed through healthy tissues without producing destructive changes. In comparison with other tumors, for instance lymphomata and certain sarcomata, carcinoma is less sensitive. This radiosensitivity is, on the whole, rather moderate, varying within certain limits.

Haendly has made histopathological studies of cancer tissue of the uterus which had been subjected to irradiation. There is a primary injury of the cancer-cells which leads to a disturbance in their growth, lack of mitosis and giant cell formation, the character of the epithelial cells is changed, and finally there is a disappearance of some of the cells through complete destruction. One notes a tendency for connective tissue new-growth to replace the destroyed carcinoma-cells. Through overdosage, this new-formed connective tissue may become sclerotic and degenerated, just as does the rest of the connective tissue. The smooth muscle atrophies and disappears almost entirely. Some of the muscle fibers show hyaline degeneration.

The destruction of cancer-cells by roentgentherapy has been demonstrated histologically by various reliable investigators. This fact must be conceded. The histological findings reported by von Franqué in three of his own cases who underwent hysterectomy after roentgentherapy illustrate very well the different degrees of change which have been described by many authors.

The first case was a carcinoma of the cervix, just at the borderline of operability, the results here illustrating inadequate treatment. The effect of the rays was not very uniform: in some places there was no change, and in some advanced necrosis, at the boundaries between the tumor and sound tissue there were areas where there seemed to have been a stimulating action. The greater part of the carcinomatous tissue was in the stage which has been described as hypertrophic, the cancer cells were enlarged and the nuclei plump and hyperchromatic.

The second case was an advanced typical pavement epithelial carcinoma of the cervix. The operation was performed the day after the last irradiation. The effect was much

more complete than in the first case. There were some small carcinoma nests remaining, but the great majority of the carcinoma-cells, not only on the surface, but deep in the tumor, were in varying stages of destruction. From the picture they were justified in assuming that a continuation of the irradiation would have completely destroyed the tumor. The specimen showed beautifully the different reactions of the different tissues. The epithelium of the uterine glands in the immediate neighborhood of destroyed carcinomatous foci was absolutely unchanged, while the connective tissue appeared to be undergoing active proliferation. In some places the connective tissue looked like young granulation tissue, and contained abundant multinuclear giant cells, which were doubtless engaged in the work of disposing of the dead carcinoma-cells.

The third case was a typical adenocarcinoma of the cervix, with ulceration at the os. The patient was first curetted and cauterized and then treated with radium and roentgen rays. Finally, on account of a small, persistent ulcer, the patient requested operation and the radical abdominal operation was done, a little over a month after the first of the two series of treatments which she received. The patient died six days after the operation from a cardiac complication. The outcome was all the more unfortunate because histological examination showed there was no carcinoma left after the radiotherapy. This case shows that adenocarcinoma may be cured by a combination of cautery and radiotherapy.

The effect of the radiotherapeutic treatment is very helpful in the temporary relief of symptoms. Although my remarks are intended to discourage the building up of too much hope in radiotherapy as a means of permanent cure, I would not have you discount in the least the great helpfulness of this method in a palliative way. One of the first effects of the roentgen rays is the disappearance of pain, even of severe pain, sometimes not until after a prodromal exacerbation. Even in the most unfavorable cases where the effect on the size of the tumor is only slight, quick and permanent relief from pain is often

secured. Only rarely is the analgesic effect lacking. Almost all authors report at first a temporary inflammatory swelling and increased secretion from the tumor, but soon the bleeding and the putrid secretion stops and there is only an odorless serous discharge which disappears in a few weeks. With the favorable cases, there is seen within the course of a few months, or possibly sooner, a contraction of the growth, ulceration heals over, and the cervix regains its normal form. Finally senile atrophy of the genitalia supervenes. Decrease in the size of the tumor is often only superficial and unsatisfactory, but the general condition is usually improved. There is diminished cachexia and anemia and usually the patient gains in weight.

It is regrettable that there are some untoward effects which occasionally are observed in spite of all the precautions we are at present able to exercise. As compared with the seriousness and disagreeable nature of the symptoms of carcinoma, the untoward effects are relatively unimportant. The degree to which untoward effects are experienced differs greatly according to the patient and according to the size of the doses. There may be weariness even to prostration, fever, nausea, and perhaps vomiting. If the rays are used a sufficient length of time, there may be a severe anemia. Some of these effects are due to the rays themselves and to the changes brought about in the air in the room by the high tension currents. Others are due to acidosis brought about by the absorption of the products of cell destruction. Bladder irritation is occasionally a distressing complication. The writer has seen rectal tenesmus in only a few cases following roentgen treatment, although after radium treatment this is a fairly common complaint. These various untoward symptoms disappear very soon after the cessation of the treatment.

Through the courtesy of one of my colleagues, Dr. Paul Roth, I have been able, in a number of cases undergoing treatment, to secure the estimation of the acidosis by the CO_2 tension in the alveolar air and acetone in the expelled air. The figures thus far have seemed to tend to support the idea advanced by S. Lange that many unpleasant

constitutional symptoms following deep roentgentherapy are the result of an acidosis, either local or general. Lange prescribes sodium bicarbonate, thirty grains every three hours, to be continued for forty-eight hours after each treatment, and in some cases for twenty-four hours just previous to each treatment.

There are occasional reports of some untoward late skin effects concerning which we are as yet unable to speak authoritatively. It is now known that the absence of visible reactive changes, erythema, or pronounced roentgen effect offers no guarantee that skin injuries will not appear later. Skin that has been irradiated is hypersensitive to mechanical, thermic, and chemical irritations. This increased sensitiveness only appears after a latent period. This latent period seems to have been greatly lengthened by improved methods of filtration, but the untoward changes have been encountered as late as a year and a half after irradiation.

Late skin changes may manifest themselves in two ways. (a) There may be a slow development into different grades of a chronic reaction or (b) a long time after the last irradiation the late changes may suddenly appear on the apparently normal skin. Injury to the vessels seems to play an important part in the development of chronic roentgen burns after deep irradiation. Gauss believes the cause of the late injuries is an insufficient filtration of the softer rays. One must also consider the possibility of late injuries of internal organs, especially of the gastrointestinal tract. My experience has been fortunately free from any serious late effects after roentgen treatment of carcinoma of the uterus. In fact, the contrary has been our experience. One patient with recurrent carcinoma of the uterus experienced severe acute enteritis for two or three days following each series of roentgen treatments. In two cases of vesicovaginal fistula the leakage of urine into the vagina stopped for several months. Even though untoward effects of a serious nature should follow roentgentherapy in advanced cases, a local inflammation of the skin lasting from four to six weeks is not too dear a price to pay for a grateful arrest of the

disease and a possible, though not probable, cure.

In summarizing the results, it is very difficult to separate the cases which have been treated by roentgen rays or radium alone from those which have been treated by the combined application of these two agents. In the great majority of cases, radium or mesothorium has been used internally and the roentgen rays have been applied to the skin and sometimes by the vaginal route.

The reports by Bumm and Warnckros have been the most enthusiastic. Bumm has also ventured farthest in the administration of gigantic doses of hard rays. An irritation of the skin and the vesicular detachment of the epidermis which healed after three or four weeks, which was practically always experienced by his patients, he did not consider of any consequence. He reports cases of cervical carcinoma as large as the fist without any parametric involvement in which a clinical improvement began within a week and which were symptomatically cured within five weeks. The treatments were given both by the vaginal and the percutaneous methods. The skin overlying the pelvis was divided into twelve to twenty-four squares, through which treatment was given in prodigious doses. After a few more years, it will be interesting to learn the final results in these cases. At any rate, the palliative effects have been extremely satisfactory.

Siellmann reports that of sixteen cases of uterine carcinoma, two were very favorably influenced, and six were materially improved. Forty one were prophylactically rayed after operation and remained cured.

Von Eiselsberg sums up the effects of roentgen rays in his observations as noteworthy and requiring further endeavor. None of his cases were operable, for von Eiselsberg insists that operable carcinoma must still be removed by operation, and that only inoperable or recurrent cases should be left to roentgen treatment.

Fueth and Ebeler report "favorable" results, especially in recurrent cases, but no mention is made of cases in which they believed cure had been effected.

Scherer and Kelen in 103 cases of inoperable

carcinoma of the uterus treated since 1910 by the roentgen method report twenty-four cases showing a remarkable decrease in the local and general symptoms, in three cases entire disappearance of the tumor, in two cases apparently recovery for more than three years. In addition, two of their apparently inoperable cases became operable after treatment.

And so one might go on through a long list of reports, some encouraging, some discouraging. My intention was to give a brief summary of the results of each of the authors who have published their statistics, but in only a few instances did their statistics cover cases which had been treated by the roentgen rays alone. Usually, as above intimated, the treatment has been a combined treatment, including radium or mesothorium roentgen rays, and in many cases cauterization or diathermia. It seems reasonable that the hot water cautery method as advocated by Percy and others will prove a valuable adjunct in certain of these cases.

In brief, the results of the use of roentgen-therapy by the various men who have reported their cases are summed up in some one of the following expressions "encouraging," "great advance," "valuable results," "a decided advance in the treatment of cancer," "remarkable results," "the time is too short to say whether the improvement will be permanent, but " With the exception of a few authors whose very optimistic expressions do not encourage belief in their reliability, all conclusions as to the final results of roentgentherapy and radiumtherapy have been very guarded, although the palliative results have been greater than by any other means. In perusing the great number of publications on the subject, one realizes that the great amount of skepticism especially current in America concerning the results claimed is perhaps justified for the reason that the word "cure" has not been used with sufficient circumspection.

In looking over the literature of competent authors, it is seen that in about 25 per cent of cases of uterine cancer, the temporary effects of the roentgen treatment have been very satisfactory. That the palliative effects have

been well worth the while is conceded by all. That these effects are probably as good as can be secured by any other known means is conceded by the majority, but in only a very small percentage of the cases treated has the result been termed a clinical *cure*. From my own experience, I am not able to improve this statement. While our patients have been grateful for temporary arrest of the disease, I have yet to see the first case of definitely demonstrated permanent *cure* of deep-seated pelvic cancer following the application of roentgentherapy or radiumtherapy. Some members of this society can testify to the faithfulness with which the efforts of myself and my assistants have been turned toward the roentgen treatment of uterine carcinoma. That there are recorded cures of cervical epithelioma in the early stages must be conceded, but I have had no successful case of inoperable or recurrent uterine carcinoma treated with the roentgen rays. In no case considered operable has operation been postponed for roentgen or radium treatment.

Considering the great number of cases which have undergone the newer roentgen treatment for uterine carcinoma, the percentage of "clinical cures" is very small. Anatomical examination has shown beyond a doubt the possibility of complete removal of operable and inoperable uterine cancer by irradiation, but what, if any, percentage will be permanently cured cannot be known until after the lapse of eight or ten years. We should not lose sight of the fact that in a considerable number of inoperable and recurrent cases life may be lengthened, and sometimes the patient may be so far restored to health that she is subjectively well and capable of work for years. Pain is relieved, distressing odors are avoided, existence is made tolerable, and the fatal consequences of cancer are postponed so that in many cases the end comes through some quicker, more merciful intermittent affection. We may say with Kienboeck that almost every carcinoma, whatever its kind and location, may be favorably improved by irradiation. But only a comparatively small proportion of cases can be so greatly benefited as to be called clinically cured. To the inquiry as

to the permanency of this clinical cure, time alone can give the answer.

That inoperable cases should be submitted to radiotherapy, preferably the combined application of some cautery method and roentgentherapy and radiumtherapy will not be questioned by anyone. But, shall *operable* cases be subjected to roentgentherapy? Von Eiselsberg says, most emphatically, "No. Operable carcinoma must still be removed by operation. It is a mistake to allow the patient to choose between operation and radiotherapy."

Platau, on the other hand, advocates the substitution of radiotherapy for operation even in operable cases of carcinoma of the uterus, stating that since December, 1913, he has had a greater number of recoveries than he had with an equal number of cases during the same period of time when he was performing radical operations. At any rate, radiotherapy should be given a chance to show what it can accomplish, for the only final way of deciding between surgery and radiotherapy is, after many years, to compare a large series of cases treated by the two methods.

Meyer takes the position that today carcinoma of the cervix should be surgically treated. He reminds us of the repeated assertion that because the operative statistics are unfavorable we are not justified in concluding that a conservative treatment should be employed. Taking the practical results into consideration, we should do well to continue to operate an operable carcinoma.

In my experience, the results which have thus far followed roentgentherapy of deep-seated malignant affections do not yet war-

rant us in believing that roentgentherapy affords a means of *cure* in these deep-seated lesions. In the light of our present knowledge, it may be stated as an axiom that the X-ray treatment should not replace or interfere with the surgical treatment of uterine cancer.

Although I have not been able, either from my experience or from a perusal of the literature, to assume an optimistic attitude toward the roentgen treatment of uterine carcinoma so far as a *cure* is to be expected, I would again urge appreciation of the very satisfactory palliative results the radiotherapeutic method affords. These palliative effects have been sufficiently detailed above.

One other question remains; viz, the desirability of post-operative roentgenization. The histological proof of the possibility of permanent cure has been afforded us. The difficulties in the primary use of the roentgen method may possibly be overcome. Be that as it may, we must at present urge that all operable tumors should be surgically removed and that *all cases of malignancy should receive post operative radiotherapy*. This treatment should be applied as soon after the operation as possible, and as thoroughly as though we believed the disease was still present in its entirety, the patient's sole prospect of cure depending upon our roentgen and radium-therapy.

NOTE.—There has not been time for the discussion of technical details in this paper. The writer has elsewhere contributed to the literature of this subject a discussion of the technical details. "The Technic of Deep Roentgen Therapy," *American Journal of Roentgenology*, Vol. 11, No. 10, November, 1915, p. 811. "Roentgentherapy in Non Malignant, Deep-Seated Lesions," *SURGERY, GYNCOLOGY AND OBSTETRICS*, July, 1915, p. 70. "Roentgen Treatment of Deep-Seated Cancer," *The Physician and Surgeon* October, 1915, p. 442.

RADIUM IN THE TREATMENT OF CARCINOMA OF THE CERVIX UTERI¹

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IT is unfortunate that so much labor and time are required in attesting the true valuation of a therapeutic agent. Chemists, physicists, physiologists, and clinicians must combine the results of their many labors, and even after their work is completed it is often difficult to make the final deductions properly, to eliminate faulty methods and premature claims of over-enthusiastic pioneer investigators.

The investigation of so called cancer cures is especially difficult because of the length of time required to check the ultimate results.

Radium has proved no exception to the rule, in fact its novel chemical qualities, its absolutely original physical phenomena and the premature claims as to its wonderful therapeutic properties have doubly confused rather than clarified our knowledge of its actual virtues. It has been used about ten years in the treatment of disease, during which time it has been lauded in the highest terms, abandoned as useless by some, and denounced without trial by many. The first seven years of its use produced only scattering reports. It was in the experimental stage and available for study by only a few clinicians, and it may be said that the statistics of real value have been produced within the past three years, since the methods of application and screening have been better understood, and a larger supply of the element has been available.

From the numerous clinical data now collected, certain well-established facts may be gathered. First among these facts should be mentioned the remarkable influence of radium over uterine bleeding associated with the metropathies, fibromata, and carcinomata. This faculty alone establishes it as an agent of the first rank in the treatment of probably the commonest affection for which the gynecologist is consulted.

There is no longer the slightest doubt that it exerts a powerful influence over cancer-

cells. This influence is not the result of cauterization, as many pathologists would have us believe, nor is it because of any selective action on cancer-cells, but rather its effect on all cell life. Its effect is well described by Burnam, who states that "it can be assumed that radiation deleteriously affects all living tissue, but under this injurious influence the normal tissues are preserved because the fluids and the protective agencies of the body are all constructed to help the normal tissues, and that the pathologic tissues disappear because, weakened by radiation, they are unable to withstand the normal protective mechanisms of the body. This readily explains why a similar growth in different individuals will react differently or not at all to radiation; why slight radiation will effect marvelous changes in one case and show just the opposite changes in another. It must also be borne in mind that certain normal tissues are more resistant than others and that the latent period of radiation may be influenced by all of the above named factors and promptly points to numerous problems yet to be solved by radio-physicists. Whether the solution of these problems depends upon earlier treatment, larger dosage, more efficient screening, or by combining radiation with operation or other therapeutic agents, remains for the future to solve."

There is another point which must be kept constantly in mind by the clinician; viz., his duty and obligations to the already proved principles of the surgical treatment of cancer.

Surgery is the only treatment so far known that offers a permanent cure for cancer in the early stage of the disease. No discussion which might detract from the high esteem in which surgery is held should be allowed to filter out to the inexperienced practitioner and particularly to the public at large. Until something more satisfactory than surgery is

¹ Presented in the symposium on "Cancer of the Uterus" at the meeting of the Chicago Gynecological Society, December 17, 1915 (for discussion see p. 502).

positively proved, we must unite in the common cause of educating the public to the importance of early surgical treatment, remaining in the meantime in a receptive attitude toward the efforts of investigators to reach the common goal by other avenues. We must agree that we have about reached the limitations of operative technique in cancer eradication. No one may venture farther than the present established technique of breast amputation or radical hysterotomy. If we increase our percentage of ultimate cures it will be by earlier operation or by combining other therapeutic agents with surgery.

The most promising agent so far known is radiation, either by special X-ray apparatus or radium. Both agents are scarcely beyond their infancy and their wonderful properties seem to be manifold and lead into divers ramifications.

It is not difficult to define my attitude toward radiumtherapy after the above remarks. So far I have employed it solely as an adjunct to surgery. I have not been satisfied with the results of radical operation, not to mention the 60 to 70 per cent who come so late for treatment that even palliative measures are often useless and burdensome to the doomed patient.

As my experience with radical operation increased, the percentage of cases in which I advised it gradually decreased. I no longer recommend it in the so called borderline cases, believing that such formidable treatment, with its primary fatalities and subsequent morbidity, does not give sufficient returns for the risk incurred. It was with the idea of increasing the permanent results obtained by surgery by the combination with radium, the conversion of inoperable into operable cases, and last but not least the amelioration of the suffering of the hopeless cases, that I determined to try radium.

I regret that I can offer as yet no statistics that might show that my operative results have been improved by the use of radium prior and subsequent to operation. Such conclusions must necessarily be based upon a large series of definitely classified cases by the same operator doing the same type of

operation and following the cases for a longer period than any one has yet been able to extend their observations. Prophylactic raying after operations is now fairly well established on a rational basis. The only statistics at my convenience bearing on this point are those of Gauss, who reported that of 21 operated upon and rayed, 20 had remained free from recurrence up to six years after operation, while their previous experience showed that in 60 per cent of cases operated upon without radiologic treatment the disease showed evidence of recurrence within one year.

I also regret that I cannot produce practical personal evidence that preliminary application of radium will convert inoperable into operable cases. Improvement has been so gratifying in four of my cases that I have repeatedly urged hysterectomy, but notwithstanding my strongest arguments, three positively declined, stating that they had improved so satisfactorily that they were willing to assume the risk. The fourth has agreed to submit to operation within a few weeks. I may add that many good authorities differ as to whether or not advanced cases become operable under radium therapy. Whether or not the accompanying parametrial involvement which disappears under radiation is of malignant or inflammatory origin cannot be determined without operation and offers another serious difficulty in diagnosis. There is no doubt that radium applications prior to operation add some difficulties to the operative technique. The widespread connective-tissue changes would necessarily make the usual dissection exceedingly tedious and must be taken into consideration when it is decided to operate after radium treatment.

It is the tendency at present to operate on more of these cases than formerly, so it will be only a matter of time before the value of the combined treatment is fully known.

The results I shall present are derived from the application of radium in 26 cases of inoperable cancer of the cervix uteri and recurrent cancer following hysterectomy that have come under observation since May, 1914. All have been followed up to December

1, 1915. The list is small and the length of time that has elapsed too short to permit of practical deductions except as to the primary results of radiumtherapy. It permits me, however, to state most emphatically that radium is a great boon to patients suffering from inoperable and recurrent cancer of the cervix uteri. I have seen large inoperable carcinomata fixed in the pelvis entirely disappear within a month and the patient's general condition correspondingly improve. Bleeding was almost invariably controlled within two weeks and the foul discharge disappeared almost as rapidly. Even in cases in which the local process did not respond the bleeding was checked, the discharge changed in character, the pain usually decreased and the general condition improved for a short period. Fifteen inoperable cases were treated solely with radium. They were far advanced, showed the usual cachexia, and several were not good risks even for simple cauterization under anesthesia. Four have died and two are slowly succumbing to the disease. Five are apparently free subjectively and objectively of disease. Among the five who are apparently well are two of the earliest cases and the others were treated about nine months ago. The primary results were almost uniformly good when the condition at the time of treatment is considered.

Four cases did not respond to treatment. They were far advanced, the vagina, bladder, and rectum being involved. Bleeding was checked and the pain reduced but they gradually lost ground and died within two months.

The first case in this series was treated in May, 1914. She writes November 29, 1915, that she had a slight hæmorrhage in March, 1915, but it lasted only a day. She has been comfortable since but has lost some weight. Four in the series showed evidence of returning trouble about 6 months after treatment, but responded to further applications. It is too soon to tell how long they will remain free from symptoms.

It is interesting to observe the remarkable deodorizing action of radium. Sepsis is the commonest complication of advanced cervical cancer and the attending foul discharge is

the most disagreeable feature both to the patient and her attendants. Ten days after radium applications the odor begins to disappear and the temperature, if present, usually subsides. This effect alone has prompted several patients to state that the treatment was worth while, whatever the final results might be.

The relief of pain is usually as marked as the control of discharges. Pain is usually due to the septic complication and consequently subsides as the local process improves. The subsidence of pain, however, does not depend entirely upon this factor, as I have seen patients abandon opiates within 24 hours after the first application.

CASES CAUTERIZED PREVIOUS TO RADIUM TREATMENT

Six cases have been excoriated and burned one to five months prior to radium treatment. In every instance the disease was rapidly reappearing when radium was first applied. The first case was treated in May, 1914. She was cachectic, suffered intensely, and had an exceedingly offensive discharge. The bladder was involved, the rectal wall was infiltrated and the remaining parametrial structures fixed. She improved rapidly, gained 17 pounds in weight, and the local process completely disappeared. She remained well until October, 1915, then died after a brief illness. Her physician stated that no evidence of trouble could be found in the vaginal vault. Since she had excruciating pain in her left hip for two weeks before her death, it is to be believed that she died of metastases remote from the vaginal vault. Three of these cases are apparently free from disease twelve months after treatment.

Just at this point it is apropos to discuss whether or not it is better to burn or use the curette on sloughing masses before applying radium.

My experience leads me to believe that it is not the best mode of procedure. I am positive that it required a longer time to check the local symptoms and the subsequent histories do not show that they remained well any longer for having had the preliminary cauterization. Preliminary cauterization re-

quire anæsthesia and is attended by no little discomfort and certainly retards the primary effects of radiation. My experience is corroborated by others, especially Burnam, who recently stated that he no longer cauterized and curetted sloughing masses as a preliminary measure.

RECURRENT CARCINOMA AFTER HYSTERECTOMY

I have applied radium to malignant areas reappearing in the vaginal vault after hysterectomy in 6 cases. These cases are utterly hopeless from a surgical standpoint and unfortunately are much less amenable to radium-therapy than primary processes. In four cases the growth promptly responded to treatment but the results cannot yet be known owing to the short period elapsed since the applications were made. The first case presented a fungus bleeding mass in the vault two years after I had performed hysterectomy. Radium was used in December, 1914. She was entirely free of local symptoms when examined December 1, 1915, and her general health is excellent. Two other cases are apparently well six months after treatment. In one case the mass disappeared, but the patient died soon after from an infected kidney.

In another instance local masses have responded twice within the past year to applications, but her general condition is gradually waning.

I have related in a general way these personal experiences to show just what my results with radium have been so far. As you will see they do not prove that radium will cure cancer, for the most favorable cases have not been followed yet two years. They prove conclusively to my mind, however, that cancer of the cervix is profoundly influenced by radiation in cases that are hopeless surgically and that the results were accomplished with a minimum of discomfort to the patients. I may further add that the results so far are superior to any other method I have used in similar cases.

The primary result is often beyond the hopes of its most enthusiastic supporters. Bedridden sufferers have been given a new

lease on life and some have been improved to the extent that surgery might be beneficial when it was originally useless. The remarkable primary results caused many early workers to report cures which were unfortunately only temporary symptomatic cures. The same test of time must be applied as in surgical statistics before they are transferred to the cured column.

One point in favor of radium which should not be overlooked in the final analysis is that the present statistics will be based upon material that has passed beyond surgical relief before radium is used. If radiation can show even a fair percentage of cures at the end of five years, its usefulness will be fully established in a class of cases not amenable to any other form of treatment. The chief point of interest after all is the duration of radium treatment. The only recent available statistics that might throw light on this phase of the subject are those of Kelly and Burnam. Schmitz has also published some extremely interesting figures, but like my own, the cases can be followed only since April, 1914.

The statistics of Kelly and Burnam probably contain more cases observed over a longer period than any other single clinic can show at present. They report 57 clinical cures, 35 cases of original inoperable cancer of the cervix uteri and vagina, and 18 cases of originally inoperable recurrent cancer. One cure has lasted 6 years, 3 for over 4 years, 4 for over 3 years, 5 for over 2 years; 29 for over 1 year, and 15 for 6 months. If this list is again summarized two years hence, we may begin to learn something of the ultimate results.

Clerton and Duval's statistics approach approximately those of Kelly and Burnam in number and length of time observed and practically coincide with the latter's figures.

TECHNIQUE

There still exists a wide difference of opinion as to the proper usage of radium in treating uterine cancer. Some believe that the problem is solved when sufficient radium can be made available to give massive doses hitherto impossible owing to the scarcity of the agent.

Schauta, Kelly and Burnam, Kroenig, Wickham, and others believe in massive dosage while other equally well-known observers believe that smaller amounts applied for a longer period will accomplish the same results.

What the final conclusions will be remains to be seen, but it is generally agreed that less than 50 milligrams of the *radium element* should not be employed, lest the growth be stimulated instead of causing the necessary necrosis.

Puich, who has large quantities of radium at his disposal, finally decided upon a dosage of 50 to 100 milligrams. Schmitz used uniformly 50 milligrams giving 6 to 8 séances of from 10 to 12 hours. The course is followed by an intermission of three weeks. If examination then reveals an apparent cure, two or three applications of 500 or 600 milligram hours of radium element is given every second or third day, followed by another interval of three weeks.

This has been practically my plan with the exception that I use from 75 to 85 milligrams of the radium element and endeavor to give from 3,000 to 5,000 milligram hours within a week or ten days. One month later further applications are made according to the indications.

No one can doubt that cancer of the cervix can be entirely eradicated by radium. Unfortunately it is not the cervix *per se* that controls the ultimate termination, the outlying cancer areas in the broad ligaments and

the glandular metastases really control the situation. If the penetrative powers of radium can be made to reach the outposts of the disease, its value will be inestimable.

Bumm's widely quoted experiments which showed that the limit of the γ ray efficiency (in tissue) was about 4 cm. is now very correctly questioned by Burnam, who states that it is possible to radiate any distance by proper distribution of the applicators, all of which goes to show that the seemingly insurmountable obstacles are being overcome as experience increases. To prove that cancer can be anatomically cured will be much more difficult than any phase of the work so far accomplished. It will require not only long years of observation, but it will require as well a microscopical study of serial sections of outlying tissues removed at subsequent operations and at post-mortem findings. This is a task stupendous in itself and can only be solved in the manner recently illustrated by Schmitz, Cheron and Rubens, Duval, and others.

The scope of this paper does not permit of much more than a statement of my personal experience. I cannot offer any general conclusions other than to say that radium has a wide field of usefulness, the real value of which can be estimated only after painstaking collective studies. It has no field absolutely to itself but is merely a therapeutic agent which should be used in common with other well-established methods of treatment.

PROPHYLAXIS OF UTERINE CANCER¹

By THOMAS J. WATKINS, M.D., F.A.C.S., Chicago

THERE are no means to determine that cancer has or has not in a single instance been prevented. This paper must consequently deal with probable or possible means of prevention of cancer of the uterus.

The possible relation of traumatisms of the cervix to cancer. There has been and continues to be a belief by many that traumatisms of the cervix are at times an etiologic factor in the development of cancer. Emmet was of the opinion that laceration of the cervix was a contributing cause of cancer, as he said: "I have never known cancer to occur in women who have not been pregnant." A. Martin states that laceration and syphilis of the cervix are predisposing causes of cancer. Cullen's conclusion from the study of cases of cancer is that injuries incident to labor have a potent influence in the development of squamous cell cancer of the cervix.

The facts that cancer occurs in women who have not borne children and occasionally in virgins, that it frequently begins in the glands of the cervix far distant from the vaginal portion and at times does not extend to the vaginal surface until late in the disease, are proofs at least that there is no constant relation between traumatisms of the cervix and cancer. There are no statistics that are of much use in the study of this phase of the subject, for example, as to the frequency of cancer occurring in extensive erosions of the cervix, or resulting in cases following trachelorrhaphy or amputation of the cervix.

When a cancer is found with an erosion it is usually impossible to determine if the erosion antedated or followed the cancer. Cancer is not uncommonly found in the absence of erosions. Cases are occasionally seen with an extensive eroded surface on the cervix where cancer cannot be excluded or determined, except by microscopic investigation.

From the meager knowledge which we have of cancer, one must infer that the irrita-

tion and circulatory disturbances, resulting from traumatisms, can be the only possible causative factors in the development of cancer of the cervix and that traumatisms of the cervix are not a frequent contributing cause of cancer.

Should erosions and extensive glandular degenerations of the cervix be treated as a possible prophylaxis of cancer? The gynecologist is frequently consulted relative to these problems. It would be highly desirable to have some standard established for guidance, as undoubtedly many unnecessary operations are done for this purpose. On the contrary, I am convinced that many erosions of the cervix are neglected. An erosion of the cervix should receive attention for the same reasons that abraded surfaces should be treated when afflicting other parts of the body. It has become a habit to neglect them. They are probably most important as focal infections, but may be etiologic factors in cancer, as is an erosion of the lip, tongue, nipple, etc.

Many cases of erosion are amenable to medical treatment. The more extensive ones, with deep lacerations and glandular degenerations, require operative treatment. The operation in the bad cases, in women that will probably not have pregnancies, should be a high amputation including most of the glands in the cervix. It would seem that the presence of scar tissue in the cervix is in itself of not sufficient importance in the etiology of cancer to need serious consideration. From a theoretical viewpoint, the problem would always seem to be easily determined, but in practice one occasionally sees cases where the question of a plastic operation or a hysterectomy is a serious consideration.

Hæmorrhage after the menopause. Hæmorrhage occurring after the menopause has been established for some time should as a rule indicate hysterectomy. Hæmorrhage at that time should be considered cancer. If cancer is not found the operation is justified.

¹ Presented in the symposium on "Cancer of the Uterus" at the meeting of the Chicago Gynecological Society, December 17, 1915 (for discussion see p. 501.)

as a prophylactic measure. Cancer is the common disease that produces bleeding from a uterus that has become senile and atrophic. We believe that fewer mistakes in diagnosis are made by considering all of this group cancer than by the use of other known means for diagnosis in individual cases. This has been our practice for some years and the results have been highly satisfactory.

We share the opinion expressed by many and especially emphasized by Bloodgood that incisions into and curetting of cancers should be avoided. In only a small percentage of our cases has it been considered advisable to incise or curette for diagnosis of cancer. When these means are used a frozen section should be made and immediate operation done if a carcinoma is present. Bloodgood's study of cases would indicate

the great importance of *immediate operation* after incision into cancerous tissue.

Tumors of the uterus. Morris H. Richardson¹ contributed a valuable paper in which he strongly advocated the removal as a rule of all tumors as a prophylaxis of cancer. This principle of treatment, we believe, should apply to uterine tumors.

The dangers of malignant degeneration in fibroid tumors of the uterus have been found by statistics to be between 3 and 5 per cent. The dangers incident to operative treatment have been reduced so that they can conservatively be placed at 1 per cent. The dangers from malignant disease in fibroids are therefore three times more than from operation.

All uterine tumors should be removed as a prophylaxis of cancer, irrespective of other indications.

¹ J. Am. M. Ass. 1909 p. 1555

POST-OPERATIVE TETANUS¹

By KELLOGG SPEED, M.D., F.A.C.S., CHICAGO

THE habitat of the tetanus bacillus and its spores is widespread. The bacilli have been found in the bottom of mountain lakes in Switzerland, in the draggings of the Dead Sea, on the arrow-heads of aboriginal natives, in the bilge-water of ships, and in the clothes and on the skin of human beings. Commonly we expect to find them in street dust, fertilized soils, and in the feces of animals.

In 1887 Croussard² reported an attack of sickness resembling tetanus in three individuals who had eaten beef infected with tetanus. Two of these patients died. In 1890 Sorman³ found tetanus bacilli in the fresh stools of several different animals. Sanchez, Toledo and Veillon⁴ studied the dejecta of healthy horses and cattle to determine the presence of tetanus organisms in them and this year Noble⁵ has repeated the earlier experiments

on a more extensive scale. He examined the feces of 61 horses, 21 cows, and 1 guinea pig for tetanus spores and organisms. Of 61 horses 11, or 18 per cent, showed tetanus organisms. None of the cows gave positive result for tetanus, probably because they were examined in the winter while being fed on ensilage. The one guinea pig examined showed tetanus in the stools. Sanfelice⁶ found tetanus spores in 7 out of 23 normal guinea pigs. Pizzini found that about 5 per cent of human beings showed tetanus bacilli in their stools, the average varying from 2 per cent to 20 per cent, the higher proportion existing in men who worked about horses and stables.

Carnivora as a rule have a relative immunity for tetanus which is caused according to Walsh⁷ by a combination of bactericidal and phagocytic action on the part of the host. This immunity may be expressed moreover by the following.

¹ Zuehl. f. Hyg. u. Infektionskrankh., 25:324 219 234.

² Ann. Vet. Rev., 1914 219 231

³ Read before the Chicago Surgical Society January 7 1906 (See Discussion p. 495)

⁴ Etudes k l'appui de l'origine infect. du tétanos. Thèse de doct. Paris, 1887

⁵ Zentralbl. f. Bakteriöl. 1890 vii 250.

⁶ Zentralbl. f. Bakteriöl., 1891 ix, 18, Semaine méd. 1890.

⁷ J. Infect. Dis. 1905 xvi 232

- 1 gm of horse is destroyed by X toxin
- 1 gm. of goat is destroyed by 2X toxin
- 1 gm. of mouse is destroyed by 13X toxin
- 1 gm. of rabbit is destroyed by 2000X toxin
- 1 gm. of hen is destroyed by 200,000X toxin.

Experimental work on the fate of tetanus bacilli and toxin in the alimentary tract of animals must be inquired into in so far as it concerns the subject we are discussing. In 1899 Carrière¹ investigated the disposition of tetanus toxin introduced into the alimentary tract of animals, and he proved that enormous doses of tetanus toxin could be introduced into the stomach of animals without causing death, but these animals did not become immunized and their blood serum had not antitoxic properties. It was also determined that ptyalin destroyed the toxin, that gastric juice attenuated it, and that bile and pancreatic juice destroyed it totally. The intestinal epithelium did not seem to influence it. Rabinowitsch² concluded after some experiments that the higher the acidity of the gastric juice, the greater the numerical destruction of tetanus bacilli immersed in it, and concluded also that it was dangerous for persons to carry tetanus bacilli in the alimentary canal. Vincent³ in 1908 studied the action of the large intestine on tetanic toxin. He introduced 3,000 units of toxin into the large bowel of a guinea pig with no untoward result. Thereafter he performed laparotomy on a guinea pig, tied off 10 to 15 cm. of the large bowel and injected a like quantity of toxin into this isolated portion. The pig's abdomen was closed, the animal was kept in warm surroundings for two to three hours and the piece of bowel was removed. After being macerated, the filtered liquid was found to be non-toxic, there was not a trace of tetanus toxin. Carrière, mentioned previously, believed that the ordinary intestinal flora attenuate but do not destroy tetanus toxin. To determine this action, Vincent made bouillon cultures from intestinal contents and, after 24 hours' growth, mixed into them a certain quantity of tetanus toxin. This mixture was allowed to stand two hours and was then filtered. The filtrate produced tetanus in a

guinea pig. The conclusions he arrived at were that the secretion of the small intestine is very antitoxic, that of the large intestine is less antitoxic for tetanus toxin, and that the toxin introduced into the rectum is destroyed. Breton and Petit⁴ also endeavored to determine the permeability of the large intestine of guinea pigs to tetanus toxin by injecting up to 3,000 times a lethal dose into the large intestine via the rectum. There were no deaths after these injections. They concluded that the toxin was either destroyed or was incapable of traversing the intestinal mucosa. They took 500 times a lethal dose of tetanus toxin, incubated it with rectal contents of a guinea pig and after forty-eight hours injected the filtered liquid into the muscular tissues of a guinea pig with fatal results after 16 days. From their experiments the conclusion seemed warranted that the intestinal flora exerted a partially destructive action on tetanus toxin but the mucosa had no influence. The permeability of the mucosa to the toxin was thoroughly tested by using six guinea pigs, injecting each at five day intervals with four successive doses of 3,000 times the lethal dose of toxin. Nine days after the last injection they were able to demonstrate tetanus antitoxin in small quantities in the blood taken from the animals. By using rectal injections of antitoxin they believed that animals could be immunized against tetanus.

In the present year Sinigaglia⁵ has reviewed the subject of tetanic infections via the blood stream as found in other bacteræmic diseases. In tetanic infections the bacilli have been found in the milk, lymphatic glands, muscles, and nerves. Nicolaier⁶ found the bacilli in the sciatic nerve and spinal canal, Haegler⁷ in the medulla oblongata of a fatal case, and others as Reinhardt and Assim⁸ have found them in the blood after death, obtained cultures and positive inoculation results in animals. Schmitzler⁹ obtained the bacilli from a lymphatic gland and secured positive

¹ Compt. rend. Soc. de biol. Par. 1899

² Arch. (Hyg.) 1907, 12, 103

³ Compt. rend. Soc. de biol. Par. 1908, 202

⁴ Compt. rend. Soc. de biol. 1908, 160.

⁵ Bolon. med. 1915, 2, 87, 454.

⁶ Virchow's Archiv. f. path. Anat. 1892, 127, 128.

⁷ Rev. z. klin. Chir. 1899, 1, No. 1.

⁸ Zentralbl. f. Bakteriul., 1902, 353.

⁹ Zentralbl. f. Bakteriul., 1911, 679.

results by animal inoculation, and Hohlbeck¹ obtained positive cultures from the blood of a patient five hours before death from tetanus. The only case in which tetanus bacilli were demonstrated in the blood of a patient who recovered from the attack was reported by Vanni and Giarré.² Sinigaglia's case terminated fatally but positive cultures were obtained both from the site of injury and from blood taken from the arm. He believes that the bacilli and spores can get into the blood stream to cause a toxemia and possibly the rheumatic form of the disease without multiplying or localizing.

Can animals become permanent tetanus carriers? Noble's work seems to show that they can. In his experiments at the time of feeding tetanus bacilli and spores a capsule of carmin was given. The carmin was eliminated within 24 hours, but tetanus spores were not found until the sixth day in the dejecta from the horse, although they may have been present before that in too small numbers to give positive cultural results. One horse continued to give off spores for many months while another ceased after the fourteenth day. The stools of control horses were negative. This one horse may have been a tetanus carrier. Quantitative tests showed that tetanus spores may be found in the faeces of animals carrying them in amounts from 0.1 to 0.01 gm., but not in smaller amounts. Failures may be caused by cultural methods. We can believe then that tetanus bacilli may be present in the faeces of normal animals and may not be detected except when present in large numbers. The bacilli may multiply in the intestines of some animals which favor their growth and these animals may become tetanus carriers.

As a final biologic consideration we must understand the requirements for the development of tetanic infections which produce symptoms and death. The pathogeny of tetanic infections is a complex phenomenon which according to Vaillard³ must have the simultaneous help of several factors. This is verified inasmuch as pure tetanus spores freed

from tetanus toxin of the culture and injected by the millions into the healthy tissue of an animal are harmless. When the spores are deprived of the pre-existing toxin they are devoured by phagocytes, but if some of the same spores in small quantities are injected into the same animal's tissues when the spores are artificially protected against phagocytic action, tetanus is produced. As an example of this requirement a guinea pig, an animal very susceptible to tetanus, will resist large numbers of toxin-free tetanus spores introduced subcutaneously or intraperitoneally. These animals, however, will succumb to tetanus when but a few spores are injected mixed with unsterile sand or enclosed in a collodion sac. The foreign material with the spores acts as a barrier to the leucocytic action of the host, tetanus toxin is developed, and the animal dies from the absorption of the diffused poison.

Let us consider these biologic facts in relation to tetanus in man. For the development of tetanus in man one must have an infection with the specific germ and favorable conditions for its growth in accordance with the requirements described. Simple injuries, superficial and practically aseptic in character, do not favor the growth of tetanus spores. Trauma alone is not a sufficient aid. When tetanus develops in man we must look first for other auxiliary factors in the infected tissue, such as burning, extensive crushing or hæmatoma formations, all of which may be called traumatic results. Secondly, we must look for associated micro-organisms. Necrotized tissue from burns, crushes and ligated areas and collections of blood within tissues, favor the growth of tetanus because the usual leucocytic resistance is held at bay.

Tetanus organisms are usually encountered in soils or manure mixed with many other micro-organisms, all of which may be expected to enter a soiled wound under equal chances for growth. Some of these added bacteria favor tetanic growth, others do not, a fact easily verified clinically when the enormous number of infections are considered in comparison with the few tetanic developments. In man we must have an inflamed wound with more or less evidence of suppuration

¹ Deutsch. med. Wochenschr. 1903, 2, 272

² Riforma med. 1887, Aug.

³ J. State Med. Lond., 1914, 231, 513

for the growth of tetanus. Animal experiments have verified these statements. An amount of garden soil infected with tetanus is divided into two portions and moistened. One part is injected into a guinea pig, it dies of tetanus. The other part is heated to 80°C., a point which does not destroy tetanus spores, but does other non-sporulating organisms. After injection of the heated soil no local lesion of importance results and no tetanus develops. If later favorable micro-organisms are added to heated soil and injections are made of it into susceptible animal, tetanic death results. In practical treatment of wounds antiseptic irrigations and applications may not kill the tetanus organisms but they do kill or greatly reduce in number associated organisms which assist in tetanic growth, probably by consuming oxygen.

Tetanus in civil practice has become almost eradicated by the prophylactic use of antitoxin and the antiseptic treatment of dirty, contused and lacerated wounds. Cases of non-traumatic tetanus still persist, especially the unforeseen post-operative cases. Let us apply the pathogeny of traumatic tetanus to these other forms of non-traumatic tetanus.

Natonck¹ believes that spontaneous or non-traumatic tetanus must be instituted from either pathologic or physiologic processes, and that the usual entrance of the infection is through the outer covering of the body, seldom through the internal organs. Wounds of the navel in the newborn and post partum and abortion infections in adults may be considered as physiologic wounds. Pathologic wounds are found after injections, vaccination, and after operations.

The following forms of non-traumatic tetanus are possible:

1. Cryptogenetic or rheumatic tetanus, which occurs as a delayed infection after a trauma or an unknown atrium of infection.

2. Tetanus after skin lesions. These may be very simple and unsuspected as an infection atrium. Kirmisson² has reported two cases, and Broca³ one case of fatal tetanus in a child from the use of felt pads to compress

the spine in the treatment of scoliosis by Abbot's method; small skin excoriations made by pulling the felt pads under the body encasements of plaster became the seat of tetanic development. Organisms were found on the felt. Sterilization of the felt before use is now considered necessary. The skin lesions may be—

a. In connection with mechanical lesions, such as ulcers of the leg, infected tumors, nasal excoriations or paraphimosis;

b. In connection with bacterial skin lesions;

c. In connection with thermic lesions as burns or frost-bites.

3. Tetanus from the respiratory and digestive tracts.

This includes also infections through the ear, a few of which are known. Through a healthy lung the infection is not possible, but in chronic bronchitis, bronchiectasis or lung-abscess cases have been found. Infection via the tonsils is known. Luckett⁴ has recorded a fatal case of tetanus in a child with the point of infection in the cavity of a tooth. Tetanus bacilli were found among other organisms in the tooth and their character was proved by inoculation experiments. Intestinal infections in tetanus carriers may have been the cause of many of the cryptogenetic or rheumatic cases, as I believe they have been in many of the post-operative cases. Most writers have considered them a remote possibility. A few cases in connection with typhoid fever, pericæcal abscesses or fecal impactions in the rectum have been recorded.

4. Tetanus after injections, from hypodermic needles, from infection carried in from the skin surface or from mixtures injected, such as gelatine.

5. Tetanus after vaccination. Usually from secondary infection by tetanus bacilli, rarely and practically never at this time from the vaccine. McFarland⁵ collected 14 post-vaccinal tetanic infections, all secondary. Wadsworth reviewing the cases of tetanus in Philadelphia for the 25 years from 1885 to 1909 found 12 post-vaccinal cases, 9 of which

¹ *Zentralbl. f. Grenzgeb. d. Med. u. Chir.* 1913, xvi, 396.

² *Bull. Acad. de mèd. Par.* 1914, lxxi, 745.

³ *Arch. de mèd. d. enf.* Par. 1914, xvi, 601.

⁴ *Med. Record* 1900, lxxv, 319.

⁵ *Lancet Lond.* 1902, September 13 and *Proc. of Phila. County Med. Soc.* 1902.

were doubtful as to the origin of the infection and were probably secondary, while 3 seemed to be primary infections from the vaccination.

6. Tetanus after operation.

In this class I wish to place tetanic infections occurring after elective operations in cases which are classed as clean from the first. The possible avenues of infection are: (1) the operator's hands, (2) the instruments, dressings, and ligatures, (3) air infection, and (4) the patient himself. This last source has been considered remote, and Matas¹ was the first to call serious attention to it. A large majority of the reported post-operative cases in the pre-aseptic and early aseptic era were connected with operations in the female pelvis. Olshausen² in 1886 collected 49 tetanic cases occurring after ovariectomy. Picherrin³ in 1901 collected 98 cases and Zacharias⁴ in 1908, 72 tetanic cases after operations on female genitalia. Other large collections especially those made by veterinarians followed castrations. A few cases followed operations other than those of gynecologic character. Brunner⁵ reported a case after a goiter operation, injection of the wound secretion in a mouse causing tetanic death. Wilms in the ten years from 1868 to 1879 found 5 cases after herniotomy. Calmesco, quoted by Natonek, reported 4 cases after breast amputations, and Santos-Fernandez⁶ a case after enucleation of the eye. Natonek states that there was less post-operative tetanus in the two decades preceding 1900 than in the decade to 1909. Undoubtedly there were more operations in this last decade and probably the increase in the number of cases can be attributed to the larger number reported and not kept secret by many operators.

Because post operative tetanus has not disappeared from aseptic surgery operators have been forced to seek a cause for the infection on which to lay the blame. Naturally animal ligatures—catgut—have become the cynosure. Two points in that connection

are worthy of attention. In the early days of catgut use for buried suture and ligature, very little was ever said or noted concerning tetanic infection from it. In the first decade of this century, in spite of the enormous amount of catgut used there are only some sixty cases of tetanic infection which are even remotely attributed to its use. In 1898 Koch⁷ reported a case of post-operative tetanus in a woman on whom a supravaginal amputation of the uterus had been performed. He found an abscess with a piece of catgut in the contents. Kuhn⁸ in 1906 detailed elaborate directions for the only safe method of rendering catgut sterile for ligature purposes. Two of the 72 cases previously referred to reported by Zacharias occurred during recent aseptic surgery following removal of ovarian tumors which were adherent to the other abdominal contents and because they occurred within ten days of each other they were considered as being caused by inborn infections. Jerie⁹ studied an epidemic in the Prague clinic in 1897 and 1898 and 4 cases which occurred in 1906 after gynecologic operations. The catgut was not considered at fault. Leyden and Blumenthal in *Nothnagel's Handbuch* reported two fatal cases after hysterectomy, and Meinert¹⁰ reported 3 post-operative cases, one of which was supposed to be caused by a Bozemann's uterine catheter. Bertarelli and Bocchia¹¹ showed that sterile catgut could be prepared simply. In the same year (1909) Worthe showed the lack of tetanus danger in raw catgut by animal experiments. Raw catgut was placed subcutaneously in 680 mice, 7 of which died within four weeks, none of anthrax or tetanus. Bocchia¹² examined 200 strands of raw catgut bacteriologically with negative results. Tournau¹³ in 1904 had recorded a case following a herniotomy, onset occurring on the ninth day after operation, but the patient had sustained a gunshot of the foot on the day before herniotomy. The gunshot wound

¹ Tr. Am. Surg. Ass., 1909.

² Bulroth's *Handb. f. Frauenkrankheit* 1886.

³ J. méd. de Bordeaux 1901, 53.

⁴ *Muenchen med. Wchnschr.* 1908, 5 and 7.

⁵ *Beitr. z. klin. Chir.*, 1901, 22.

⁶ *Rev. gén. d'ophth.*, 1906.

⁷ *Deutsch. Ztschr. f. Chir.*, 1898, 21vii.

⁸ *Muenchen med. Wchnschr.* 1906, 21, 41.

⁹ *Mitt. a. d. Gesellsch. f. innere Med. u. Chir.* 1908, 212.

¹⁰ *Arch. f. Gynaek.*, 1903, 21iv.

¹¹ *Zentralbl. f. Bakteriol.* 1909, 1.

¹² *Riv. d'ig. e san. pubb. Roma*, 1910.

¹³ *Deutsch. med. Wchnschr.*, 1904, 20.

had been opened and pieces of shoe removed from its depths. Reinhardt and Assim¹ reported a fatal case of tetanus after herniotomy on a 19 year old male. A small abscess was found from which smears and cultures were made showing tetanus bacilli. Virulent tetanus bacilli have been found in small granulating wounds as late as two and one-half months after tetanus symptoms had disappeared.

Richardson² reported 2 cases of post-operative tetanus, one after an omental hernia and one after a gall-bladder operation, and collected in all 21 cases in which the infection had been laid on the catgut used. It was believed that many of these cases occurred in regions in England in which there were tetanic sheep, or sheep infected with louping-ill described by Hamilton. This sickness is characterized by trembling muscle spasms and occurred mostly in the spring of the year. Consequently the post-operative cases in man were attributed to infection from the sheep gut, but on investigation it was found that the sheep gut used as ligatures had all come from Germany and from 14 of the 21 cases the gut had been examined. Four contained a bacillus resembling tetanus but animal experiments with the organism proved negative.

In surgery, operations other than laparotomy occur twice as often as opening the abdomen, and more ligatures are used in them, but in 19 of the 21 cases collected by Richardson the operation was a laparotomy and handling or suturing of the bowel was performed. Richardson cited the experience of one operator who on a certain morning performed 5 laparotomies, using the same preparation of catgut. Patients number 3 and 4 in this series, a gall stone case and an appendectomy respectively, developed tetanus, but the other cases did not.

In 1909 Matas³ called attention to the risk of tetanus infection in operations on sterile tissues in which post-operative asepsis cannot be assured. Operations on those parts of the body exposed to faecal contamination

are the doubtful ones because of infection derived from faecal discharge. The genito-urinary organs of both sexes, the anorectal regions, the sacrococcygeal region, and the inner surfaces of the thigh or legs or any other part of the body which might be contaminated, lie in this class. After two personal cases Matas advised abstinence by the patient for several days prior to operation from such foods as might carry tetanus. Raw vegetables and other food as lettuce, celery, cabbage, watercress, radishes, tomatoes, etc., and raw fruits as strawberries, blackberries, etc., must be removed from the diet and a free catharsis instituted for three or four days previous to operations on the areas named previously. If this preparation cannot be made, Matas advised a prophylactic dose of antitetanic serum. By these means it was hoped that the occasional case, 1 in 10,000 or 15,000 might be saved from a post-operative tetanus. Lucid⁴ reported a case of post-operative tetanus after oophorectomy and endorsed Matas' instructions for preliminary cleansing of the alimentary tract. It is believed that the lowering of the peritoneal resistance by operative handling and separation of adhesions permits the emanation of tetanus bacilli which lie within the canal, out into the damaged tissues which in normal state would be able to resist.

Atkinson in 1915 reported a case of post-operative tetanus following removal of hemorrhoids and found that there were but six other cases, those of Matas,³ Shaw,⁵ Wood,⁶ Souchon, Gerrish and de Nancrede (discussion of Matas' paper). He omitted Jacobson's case in the same discussion and that of Wadsworth, who found one case after hemorrhoids in his examination of Philadelphia⁷ records.

Through the kindness of Dr. Irons I have been informed of three of the following six cases. Two cases occurred in surgical service at the Cook County Hospital, Chicago.

CASE 1. Abdominal hysterectomy for fibroids, salpingo-oophorectomy appendectomy. Onset of

¹Zentralbl. f. Bakteriöl., 1909, 40.

²Brit. M. J., 1909, L, 948.

³Tr. Am. Surg. Ass., 1909, 40.

⁴Buffalo M. J., 1900, VI, 395.

⁵Tr. Am. Surg. Ass., 1909.

⁶Month. Homoeop. Rev. Lond.

⁷Am. Med. Mag., 1897, 608.

⁸Tr. Coll. Phys. Phila., 1915, 2557, 154.

tetanic symptoms eleven days after operation. Death

CASE 2. Inguinal herniotomy, secondary hemorrhage. Onset of tetanus within nine days. Death.

CASE 3. Cholecystostomy. Onset of tetanus in 15 days. Death

CASE 4. Cholecystostomy with drainage. This patient was carefully prepared by two doses of cathartic and enemata and had no diet but tea and toast for three days before operation. Onset of tetanus seven days after operation. Death

CASE 5. Bilateral inguinal herniotomy. No adherence of gut within sacs which were of direct type. The patient was in the hospital three days before operation with usual pre-operative emptying of the alimentary tract. On the day after operation the patient had a tap water enema. He had no bowel movement for four days after operation. Drank milk freely, made a complete recovery and left hospital 12 days after operation. Six days later, 18 days after operation, he returned with abdominal cramps and stiff neck. Trismus developed. A small pus pocket was found in the left inguinal region, smear of which showed staphylococci only. Recovery after vigorous antitoxin treatment

CASE 6. Left sided inguinal herniotomy. Operated on day after admission, usual preparation for operative cases. Eleven days after operation the patient had abdominal cramps, shortness of breath, and pain in the throat. Convulsions followed within a few hours involving the muscles of the trunk, neck and diaphragm. Death. At the autopsy there were found suppurating adhesions of the sigmoid to the deep part of the herniotomy wound, the skin opening and external oblique fascia having healed cleanly. The deeper muscles and tissues in the wound were grayish and infiltrated with a dirty, gray exudate. One of the deep stitches used in the herniotomy passed through the peritoneal coat and wall of the sigmoid, but the mucosa was intact. Smears and cultures were made of the exudate and tetanus organisms were found. Cultures and animal

inoculations made from the sutures not entering the bowel wall were negative for tetanus

Although Matas' idea as to the source and method of infection of post-operative cases in the regions exposed to fecal contamination is probably correct, I feel that there is more to be said in regard to the retention of the tetanus organisms in the alimentary tract. Some of the cases briefly outlined above and others in the literature developed post-operative tetanus after periods of abstinence from diet which could be contaminated with tetanus and after thorough catharsis which would have emptied the bowel of previously eaten green vegetables, etc. In view of the various experimental and bacteriological data mentioned in the biologic considerations, it seems possible that some human beings carry and excrete tetanus organisms for long periods and are really *tetanus carriers*. Their greatest danger is to themselves because after operative procedures which permit fecal contamination of the wound tetanus may be inaugurated. This is particularly true of abdominal operations where the gut is bruised or roughly handled and opportunity for tetanus development ensues in accordance with the pathologic requirements. The possibility of hematogenous infection must also be weighed. Considering the great number of anorectal, gynecologic, and intestinal operations and the few post-operative cases of tetanus resulting therefrom, it seems that we may attribute those few which are constantly occurring in spite of pre-operative preparation to tetanus carriers

ANTHRAX

WITH REPORT OF CASES¹

By J S ULLMAN, M.D., NATCHEZ, MISSISSIPPI

A REVIEW of the available literature reveals such a paucity of cases of anthrax in the human race that these are herewith presented. Because such cases are seldom seen in this country, and because it behooves the surgeon to be constantly on his guard lest they may be unwittingly admitted to his wards, it may be well to consider, briefly, the disease itself before taking up the history of these cases.

Anthrax (charbon, malignant pustule, splenic fever, woolsorters' disease, milzbrand) may be defined as "a specific disease caused by the bacillus anthracis, usually communicated from the domestic animals to man, and characterized by a specific lesion at the site of inoculation in the skin by oedematous swelling and lymphatic inflammation, or by intestinal or pulmonary lesions, with general infection, splenic enlargement, grave constitutional symptoms, and high mortality" (1 and 2).

ETIOLOGY

Prior to the discovery of the bacillus many theories as to the cause of the disease were advanced. For instance, Keen (1) quotes Heusinger as declaring anthrax to be "a malarial neurosis dependent upon conditions of climate and soil".

The bacillus anthracis was the first pathogenic bacterium discovered, and the work of Koch, Pasteur, Klebs, and others has made it probably the best known of all pathogenic micro-organisms. Osler (3) states that "geographically and zoologically anthrax is the most widespread of all infectious diseases".

The organism is rod shaped (being from 5 to 20 microns by 1 to 1.25 microns in size) with square ends. It stains easily, grows rapidly, and produces highly resistant spores and long threads in culture. It is interesting to note that at a temperature below 18° C. and above 42° C. spores are not produced.

The cultures grown at the higher temperatures lose their spore-producing properties, and even upon reinoculation into animals this power is not regained. This fact is taken advantage of in the production of anthrax vaccine.

The disease is transmitted to man only from the infected animal, by bandling the animal or its excreta, or it is transmitted from the hides, hair, or other portions of the carcass. "It results always from infection either through the skin or intestines, or in rare instances through the lungs" (3).

In the lower animals it may be conveyed by the bite or sting of insects, or by feeding upon infected carcasses, but most often it is conveyed from grazing in infected pastures. It has been shown that pastures long free from infection may be contaminated by material brought upon the land by overflowing streams. This probably is the manner in which the epidemic, reported below, started. Pasteur was able to show that earthworms working above graves of infected carcasses would bring the bacillus to the surface, where it would be deposited in their excreta.

Males are affected, according to Legge (1), in 96 per cent of cases. The point of infection is most frequently located upon the fingers, hands, forearm, face, head, and neck.

PATHOLOGY

The pathological changes are not constant, but the muscles are usually darkened and may be hæmorrhagic. Ecchymoses may occur, beneath serous surfaces, of all portions of the body. The spleen is enlarged much more frequently in the lower animals than in man. The liver may, or may not, be involved.

The "malignant pustule" is really not a pustule, since bacillus anthracis is not a pyogenic organism. Pus, if present, occurs when the necrotic portions begin to slough,

¹ Read before the Hoochett Valley Medical Society, Natchez, Miss. October 13, 1915.

Last June every animal on the place was vaccinated against charbon, excepting one cow, which escaped the negroes that were driving the animals up. On September 9, 1915, this cow was found dead on the range. There being nothing about the external appearance of the animal to indicate that she had died of charbon, the carcass was ordered skinned.

On September 11 one of those who had helped to skin the carcass, Frank Williams, colored, aged 15, became ill and it was noticed that his feet were swollen (but after the 15th the entire left side of the trunk became swollen), he had high fever all the time, though about the 15th his skin became cold and clammy, there was nausea and vomiting after this date and the urine was scanty and red. The mind remained clear until the end which occurred on the 17. (This negro died without having consulted a physician and the above history was obtained from his mother by Dr. M. C. Reeves, Vidalia, Louisiana.)

September 16 Tom Davis (who had skinned the carcass), colored, aged 43, began to feel bad and noticed a burning, itching place on his right ankle, but thought he had been "snake bit" the day before. Continuing to feel bad he consulted Dr. Reeves at his office (September 18, 11 a. m.). His temperature at this time was 102° F. and his pulse 100. There was a small "pustule" on the right ankle, posterior to the internal malleolus. There was a little swelling at this time. September 19, 5 p. m., the temperature was 102° and the pulse 100, while the foot and leg were more swollen than the day before. There was little pain in the leg. The patient, however, complained of pain over the bladder region and micturition was difficult, later in the evening it became necessary to catheterize. There was also a sensation of constriction around the pelvis which was not relieved by catheterization. The sensations in this region disappeared as the disease progressed. On this date patient began to complain of nausea which continued throughout.

September 20, 8 a. m., the patient was restless and the temperature and pulse were elevated to 103° and 120, respectively. Upon catheterization only 3 ounces of urine were obtained and this was bloody in appearance. The oppressive pain was described as being higher up on the abdomen. The leg and foot were very edematous and the lesion was elevated above the surrounding tissues and now consisted of a hard, black crust surrounded by vesicles, around which was a widespread boggy swelling. Hot carbolic compresses were applied and the foot elevated. At 3 p. m. he was again catheterized but only a very small quantity of urine was obtained. The temperature now registered 105° and the pulse 140. The patient was restless and com-

plained of an oppression about the chest. At 5 p. m., the temperature had dropped to 102°.

September 21, I saw the patient in consultation with Dr. Reeves. The temperature was 103° and pulse 140, the patient was restless but the urine had become clear. A sample of this urine showed no albumin and no erythrocytes, but granular casts were present.

An incision was made posterior to the internal malleolus down to and including the tendon sheaths which were very tense with edema. All the tissues were rather pale and had a gelatinous appearance. No pus was found. A drainage tube was inserted in the tendon sheath, and a hot bichloride dressing applied. At 8 p. m., the temperature and pulse were the same, but all other symptoms appeared aggravated.

No serum being at hand, it was decided to employ anthrax vaccine (in the same manner as typhoid vaccine is employed in that disease). Of the veterinary vaccine (No. 1 of the double dosage) 0.1 ccm. was injected without apparent result.

September 22, 6.40 a. m. The temperature was 97° and pulse 150, the skin cold and clammy and the patient much weaker. Saline enemata were given, as well as hypodermics of strychnine and atropine.

As an emergency measure we decided to use serum, and a horse which had been inoculated against anthrax was accordingly bled for that purpose. By 6 p. m., 130 ccm. of serum had been procured and this was given intravenously, and followed by 1000 ccm. of physiological saline containing 0.5 ccm. of digital. In spite of this treatment and the use of other stimulants, at 9 p. m. the temperature was below 94° and the pulse 160 while the breathing was labored though regular. The patient died at 4 a. m. of the 23d.

Spleens and cultures obtained from the wound, the blood, the spleen and the peritoneal fluid all showed anthrax bacilli. The spleen was not enlarged. The tissues were pale and anemic.

On the afternoon of the 23d two negro men (Robert Thompson, 35 years, and Eddie Bolden, 19 years—who had hauled the hide away) were found to be complaining of headache, pains in the back and knees and were feverish. The older one had had a chill. An injection of 50 ccm. of serum was given intramuscularly to each and repeated the next day. Purgatives were also administered. Within 48 hours both negroes were apparently well again.

We were unable to prove that the last two negroes had anthrax, but we feel that we

¹ Since writing the above paper the following suggestion was made by Dr. E. A. Runk, State Veterinarian, Agricultural College, Mississippi. That a horse be hyperimmunized by giving him 10 ccm. of the second part of the double anthrax vaccine for animals. Its dosage will be a safe one and will produce a large quantity of antibodies in the horse at the end of about forty-eight hours at which time the animal should be bled at 1 serum prepared.

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possible to prove the precipitinogen of anthrax not only in the fresh filtrates of visceral organs, but also in material which has been preserved on ice for more than three months. The extractive may be prepared in physiological salt solution, distilled water, or even ordinary tap water. It is stated that putrefaction of the extractive does not interfere with the test. The suspected material is boiled in an acidulated physiological salt solution (acetic acid, 1:1000) for a few minutes, filtered through asbestos, and the *clear* filtrate is examined by floating it on a layer of precipitating serum, after which it is compared with a control tube containing normal serum. This method has been in use in several veterinary high schools of Italy and has been employed by individual workers elsewhere.

PROGNOSIS

The prognosis is always grave, but less so in the external infection. The pulmonary type gives the highest mortality rate, stated by different observers as ranging from 50 per cent to 75 per cent.

Where the infection attacks the extremities the prognosis is more favorable than where the infection is about the head and neck. Mixed infection, with its attending dangers of pyæmia or septicæmia, increases the gravity of the situation.

TREATMENT

In taking up the treatment the prophylaxis is of the utmost importance. All discharges from the animal or patient should be thoroughly disinfected and burned. The body of animals or human beings dying of this disease should be covered by wrappings soaked in an efficient disinfectant and burned. No post mortem examination should be allowed. Flies, mosquitoes, and other insects have been shown to convey the infection and should therefore be guarded against. It has been shown by Osler that the ordinary processes of tanning do not affect the spores. Animals may be protected from infection by vaccinating with attenuated, non-spore forming cultures. Every farmer is familiar with this method.

The curative treatment is admitted by all

to be essentially surgical. Wide incision at the point of infection with efficient drainage, and hot, moist, antiseptic applications, if instituted early, offer the greatest hope of recovery.

Of course all sorts of medication have been tried. Some propose emesis and purgation in order to free the alimentary canal from as many bacilli as possible. Others hope to obtain the same results by the use of quinine (in doses of from 15 to 60 grains per day) or by combining quinine and carbolic acid, or the use of a solution of iodine and potassium iodide internally.

Injectations of a 5 per cent solution of carbolic acid into the tissues at the outer edges of the cedematous area are claimed to be of value.

Probably the administration of Scelavo's serum offers more hope than any other agent. Scelavo states that he relies upon this alone. In a large number of cutaneous cases his mortality rate was only 6.09 per cent as compared with 24.1 per cent for all cases in Italy.

Scelavo recommends the use of doses of 40 ccm divided into four parts, but Bandi (quoted by Keen) has used as much as 150 ccm. Bandi contends that the method of Scelavo fails because there is not a sufficient quantity of the antitoxin to neutralize the virulence of the poisons of the disease. Kept cool in a dark place the serum remains fully active for at least two years.

Bouchard and Carrhin claim that the toxin of bacillus pyocyaneus has a curative effect in anthrax. The injection of this toxin, or the use of the carbolic injections, should be undertaken if the serum cannot be had.

The cases herewith reported are interesting in many ways. They occurred on a plantation where there had been no charbon for twenty years past to a certainty, and possibly longer.

The pasture of which we are about to speak is outside of the levee and, of course, has been overflowed repeatedly. This is probably the most likely method by which the land became infected. We must bear in mind, however, that the infection may have been brought by buzzards, or perhaps by a stray animal.

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were doing the safe thing in administering the serum after the experience just mentioned

The above conclusively shows that the handling of infected material is dangerous in the extreme.

That the serum obtained from an animal immunized by vaccination may, in all probability, be too weak to be of curative value.

That where a regularly standardized serum — such as Sclavo's — cannot be obtained, an emergency serum should be prepared from a recently vaccinated animal, if a competent bacteriologist be on hand to make it

That such a serum may be of value as a prophylactic agent.

That any serum should be employed in large doses — from 150 ccm. to 250 ccm. — and given intravenously, where possible, and repeated every 6 to 12 hours, if necessary.

I wish to acknowledge my indebtedness to Dr. M. C. Reeves, Vidalia, Louisiana, and to Dr. M. Beckman, Natchez, Mississippi, for the use of notes on these cases; and to the latter is due credit for the idea of making the emergency serum mentioned above

REFERENCES

- 1 Keen's Surgery, vol 1
- 2 Bryant and Buck, vol 11
- 3 Osler's Practice, p 143
- 4 Ref. Handbook of Med Sc, vol 1

RENORENAL REFLEX PAIN

REPORT OF A CASE¹

BY H. A. FOWLER, M.D., F.A.C.S., WASHINGTON

PAIN is one of the cardinal symptoms of stone in the kidney. In a typical case, this pain is so characteristic that taken together with the urinary changes, it readily leads to a correct diagnosis. But it requires very little experience to convince one that in many cases of renal calculus the pain is so atypical in character as to be confusing and misleading. Indeed, it may be said that in no other organ of the body is pain so variable as to location, duration, intensity, and irradiation. This is abundantly evident from the statistics dealing with this symptom in a large series of cases. Thus, Braasch in a clinical study of 251 cases of nephrolithiasis states that in only 46 per cent was the pain referred to the affected kidney alone and did it radiate downward along the ureter. Irradiation of the pain was noted as follows: to the gall bladder in 12 per cent, to the lower abdomen and laterally suggesting appendicitis in 12 per cent, in 22 per cent it was referred to both sides, and in 16 cases or 6 per cent, pain was referred chiefly to the non-affected side. Cabot has shown how frequently other innocent organs have been

attacked surgically through an error in diagnosis based upon subjective symptoms alone.

That pain produced by a stone in one kidney may be referred entirely to the kidney of the opposite side was first pointed out by Knowsley Thornton. This assertion was based upon his own operative and autopsy experience. And he concluded that the reason why stones were not found in certain cases where the symptoms were characteristic was that the pain was transferred, and that it was really the healthy, though painful, kidney that had been operated upon.

Guyon, as a result of his clinical investigations, was led to the conclusion that in the pathology of the urinary tract there are three important reflex groups to be considered, and the most important of these reflexes are the renovesical, vesicorenal, and the renorenal reflex. Guyon stated that renorenal reflex pain is common in nephrolithiasis. This form of reflex pain was accepted by Legueu, who called attention to the fact that in some cases, pressure over the painless kidney containing the stone produced, on the contralateral side, the typical pain from which the

¹ Presented in abstract before the American Association of Genito-Urinary Surgeons, White Sulphur Springs, West Virginia, May, 1915

patient was suffering. The authority for the existence of renorenal reflex pain, therefore, rests in the first place upon the clinical observations of Thornton, Guyon, and Legueu. Henry Morris, on the other hand, denies the existence of this reflex. And the great weight of his authority has been sufficient, apparently, to cause some other observers to question the occurrence of the phenomenon. In view of the contradictory opinions expressed in the literature, which are reflected in the current textbooks of genito urinary surgery, it seems worth while to review briefly the literature of the subject, to examine into the evidence thus recorded, and to arrive, if possible, at some conclusions justified by such a review.

Before proceeding with this part of the paper I wish to report a case recently under observation which seems to have a distinct bearing upon the question and which stimulated this present inquiry.

On February 27, 1915, I was called in consultation by Dr. Ada Thomas of Washington, D. C., to see a young woman, E. O. H., aged 29, suffering with what appeared to be a typical attack of renal colic. She was lying in bed with a hot water bag applied to the right loin. She was nauseated and had vomited several times earlier in the morning. At the time of our visit the pain which had always been confined to the right side, was not marked, but a few hours before and during the preceding night it had been very severe. The present attack came on a few days before, soon after going to her work at the library in the morning. She was compelled to return home. The pain grew worse and continued during the remainder of the day and the following night. This pain she described as very sharp and severe and was felt in the right loin just beneath the costal border. It did not radiate down along the ureter or in any other direction. Following this attack of acute pain she had been conscious for a few days of a soreness over the region of the right kidney and, as she described it, a deep rumbling pain, was present most of the time.

Being the daughter of a physician she was able to give a very complete and accurate history. At the age of nine years she had scarlet fever which was followed by severe dropsy. This cleared up and she was perfectly well afterward. Menstruation began at fourteen years and has always been regular and normal.

Ten years ago she had an attack of hematuria which came on without apparent cause. A day or two later she had a very severe attack of kidney colic. The pain was localized in the region of the right kidney and did not radiate. This attack was associated with nausea and vomiting. The pain

lasted only a few hours and the blood gradually disappeared. Following this attack she was perfectly well for the next five years when she had a second attack similar in every detail to the first one. There has been no recurrence of the pain up to the onset of her present illness, but in November, 1914, there was macroscopic blood in the urine. The pain in the former attacks as well as the present one had always been referred to the right kidney. There had never been any pain on the left side and no vesical irritation.

Examination. The patient is a young woman of slight build, apparently in good physical condition except for the pain in the right loin. Examination of the chest was negative. Palpation of the left kidney region elicited no tenderness, muscular rigidity, or pain, local or referred. The right kidney region was tender on palpation, painful, and there was slight muscular rigidity. Abdominal palpation was otherwise negative. The patient remarked during this examination that the tenderness in the right loin and below the costal border was much more marked during the attack of acute pain and that such deep palpation would not have been possible.

The urine, catheterized specimen, was clear, amber, acid normal gravity, and the sediment contained numerous fresh red cells, without pus or infection.

An X-ray examination made by Captain Christy of the Army Medical School showed a distinct shadow opposite the cartilage between the third and fourth lumbar vertebrae on the left side and in a line with the tips of the transverse processes. The right kidney and ureter as well as the left kidney were negative.

Cystoscopy. The bladder was normal. There was no injection of the vessels about either ureteral opening and each side was seen to functionate.

Ureteral catheterization. A wax-tipped catheter was first passed into the bladder for some distance, the cystoscope then being threaded over the catheter and introduced. In this way contact of the waxed tip with the metal instrument was prevented. The catheter was passed 10 cm. into the left ureter and a sufficient amount of urine collected for examination. A No. 7 catheter was passed to the pelvis of the right kidney. After collecting a specimen for chemical and microscopical examination the wax-tipped catheter in the left ureter was advanced slowly until it met an obstruction at a point 24 cm. from the ureteral opening. By rotating the catheter it finally passed the obstruction and advanced easily to the kidney pelvis. The tip of this catheter was then withdrawn below the point of obstruction and again advanced meeting the obstruction which was overcome in the same manner. At the completion of the examination great care was taken to avoid contact of the wax-tipped catheter with the metal of the instrument. Examination of the catheter on removal showed deep spiral grooves cut in the wax, undoubtedly due to a rough stone in the

ureter 24 cm from its bladder orifice and at a point exactly indicated in the X-ray plate.

Examination of the specimens obtained by the ureter catheter gave the following results:

	Right	Left
Reaction	strong acid	neutral
Albumin	negative	heavy ring
Urea	0.6	0.02
Microscopic	fresh red cells no leucocytes	red cells, renal cells, leucocytes numerous

Upon the evidence furnished by the X-ray plate, corroborated by the wax tipped catheter and the depressed renal function on the left side, the diagnosis of a stone in the left ureter was justified although all the symptoms had been referred to the right kidney. From the negative X-ray plate, the ureter catheter, the good renal function, and the absence of pathological elements in the specimen obtained from the right side it was concluded that the right kidney was normal.

Operation. Left ureterolithotomy. Partial closure of the incision into the ureter, cigarette drain recovery.

The ureter was readily identified and exposed by palpating the stone which was found at the point previously determined. The edges of the wound in ureter were brought together by a simple suture of fine catgut. A cigarette drain was carried down to this point. After the removal of the drain there was a very slight leakage for three days after which the wound was dry and promptly healed. The stone is oblong in shape, gray white in color, the surface bristling with sharp pointed crystals with glittering surfaces.

Convalescence was satisfactory and without incident. There has been no recurrence of the pain in the right side up to the present time eleven months after operation. Examination of a centrifuged specimen of urine six weeks after operation was negative for red cells.

Remarks. Such is the record of our clinical observation. An analysis of this record shows that our patient had a stone in the left ureter situated at a point 24 cm from the vesical end of the ureter. She had no symptoms whatever at any time referable to the left kidney or ureter. She has had three severe attacks of typical renal colic associated with hæmaturia in which the pain was always localized in the region of the right kidney and did not radiate to the bladder. There had never been any vesical symptoms. The methods of clinical examination employed failed to show any pathological process in the right kidney which might explain the several attacks of pain referred to that side. In fact nothing abnormal was found and we con-

cluded from the result of our examination that the right kidney was normal and healthy. The methods of examination included an X-ray examination of the kidney and ureter, ureteral catheterization to the kidney pelvis, chemical and microscopical examination of the urine obtained by the ureter catheter, and the comparative urea output of the two kidneys during the same period of time. I am not familiar with any further clinical or laboratory methods which might be expected to throw additional light on the question of the possible presence of pathological lesions in the right kidney, of sufficient gravity to serve as a plausible explanation for the pronounced symptoms presented.

In the absence of any demonstrable lesion of the painful kidney and with no other satisfactory explanation to suggest, I believe this to be an example of renorenal reflex pain. I am well aware of the widely different views held by different authorities as to the occurrence of this renorenal reflex pain. While some authors maintain that renorenal reflex pain must be accepted as a fact, although cases of this kind are extremely rare, others stoutly deny its existence and affirm that in the majority of cases the supposedly healthy kidney is not really sound, that the pain is due to some lesion that has been overlooked. In some instances the lesion may be outside the kidney itself as in the case referred to by Morris.

I am not however so much concerned with the existence or non existence of true renorenal reflex pain. I am more concerned in presenting a clinical observation unique in my own experience and one which I am sure from a perusal of the literature, is unusual. It matters little after all whether we do or do not accept the existence of true renorenal reflex pain. The fact remains that occasionally, though rarely, one may see a patient suffering with typical attacks of renal colic in which the pain is localized in one kidney, region and the most careful examination will fail to reveal any lesion of the kidney on the painful side, while a stone is discovered in the opposite kidney or ureter the removal of which is followed by the disappearance of all symptoms. The important consideration is

that such cases do occur and this fact emphasizes the necessity of making a complete pre-operative diagnosis in every case of suspected renal calculus before any surgical interference is undertaken. Such a complete diagnosis involves an examination of both kidneys and both ureters even with the symptoms wholly confined to one side. Had this not been done in the case here reported we would have missed altogether the stone in the left ureter, which, though located on the painless side, was unquestionably producing all the symptoms. It should be further remarked that in all cases of kidney stone the diagnosis can be considered complete only when the exact location of the stone in the kidney or ureter has been accurately determined. The removal of the calculus is thereby greatly simplified, the necessity for an extensive exploration during the operation is avoided, and the trauma resulting from the surgical interference will be reduced to a minimum.

LITERATURE

By renorenal reflex is meant a condition in which the symptoms of disease in one kidney or ureter are referred to the contralateral side, the kidney or ureter of this side being entirely normal, or presenting only slight changes, the character and degree of which offer no plausible explanation for such localization. The symptoms of renorenal reflex are pain and anuria. The underlying cause is almost always calculus disease. In three other conditions tuberculosis, pyonephrosis, and tumor, the phenomenon has been noted. As to the pain, this is completely transferred, and is so entirely confined to the sound side that the patient and surgeon are led into error in supposing the lesion to be on the painful side. The healthy kidney has been operated on for the removal of a suspected stone. As regards anuria the calculus produces complete obstruction of the affected ureter, while the other kidney, although comparatively healthy and the ureter patent and unobstructed, fails to functionate. The anuria may be complete and persist for many days and threaten the patient's life. Pain is, therefore, only one manifestation of renorenal reflex.

As already stated Thornton was the first to establish to his own satisfaction that the symptoms of stone in one kidney may be referred entirely to the kidney of the opposite and healthy side. He records several observations where the diagnosis of stone in one kidney has been made, based upon the clinical symptoms, and operation has revealed a stone in the opposite kidney. The location of the stone in these cases was determined by a preliminary exploratory abdominal incision. In this manner he was able to determine the presence of a stone in the opposite kidney which did not present symptoms. His clinical operative experience was also supported by the records of similar cases coming to autopsy. Thornton suggested that the failure to find a stone in at least some of the cases presenting typical renal colic was due to the phenomenon of transferred pain — the stone was missed by exploring the wrong, though painful, kidney.

The now well-known case of Godlee has often been quoted in support of this view. In the *Practitioner* for 1887, p. 24r, Godlee writes as follows: "Mr. Knowlsey Thornton has staggered us with the assertion that all symptoms of stone in one kidney may be caused by the presence of stone in that of the opposite side." He reports the following case.

A young man, 24 years old, was operated upon by Mr. Beck, the kidney was exposed and needled without results. No stone was found and there was no relief of colic. Later the patient consulted Mr. Godlee on account of pains located on the right side, which were so severe that it seemed best to cut down on the kidney again and incise it. This was done and the kidney thoroughly explored without finding any stone. Blood was passed after the operation, showing that the ureter at all events was not completely blocked, and no urine escaped from the wound. The colic was not relieved. Seven weeks after operation the patient passed a stone *per vias naturales*, and gave credit to Godlee for having dislodged it. Close questioning of the patient brought out that only at times did the pain shoot over to the left side. The patient felt sure that the trouble was in the right kidney. Godlee remarks that of course a stone may have been well down in the ureter on the right side without completely blocking it, or it may have been in the left kidney all the time. A footnote states that since the above report the patient was again confined to bed with left renal colic.

In the light of our present knowledge

skepticism based upon the cases above reported is entirely justified. The evidence presented by the clinical experience of Thornton, Guyon, and Godlee, while highly suggestive, is by no means convincing. The cases as reported will not stand criticism. Morris in his *Surgical Diseases of the Kidney and Ureter*, vol. II, p. 84, says.

"It is important to know that a stone in the kidney will sometimes excite sympathetic pain and irritation in the other, but, if this is transferred, or if the sympathetic pain is of an aching character, not of a spasmodic or colicky description, it is only occasional, and never occurs except as an accompaniment of severe pain of the affected side. So far as my own experiences and researches go, there is not a single case which affords satisfactory evidence of symptoms on one side only being caused by a stone in the kidney of the other side. The presence of a stone in the painless kidney is not proof that the painful opposite organ is not affected. That the attacks on the painful side have ceased after removing a calculus from the painless kidney is not conclusive, this may be nothing more than a coincidence due either to the accidental shifting of a calculus in the painful kidney, or to the calculus becoming lodged in some immovable manner. There may be very advanced disease of the kidney on the painful side and a symptomless calculus in the opposite kidney. In a case which has been under my care of late there was a sarcomatous growth in the right kidney with hæmaturia, but an entire absence of pain and tumor on the right side throughout the whole course of the disease, yet intense pain was experienced in the left renal region radiating over the left side only. The inference would have been that this was a typical case of renorenal reflex pain had not symptoms during the last few weeks of life and a post-mortem examination shown that the left-sided pain was due to a similar new growth involving the left transverse processes and the left side of the bodies of the lower dorsal vertebrae. I consider the doctrine of renorenal reflex pain with the absence of pain in the affected kidney as unproved and unsound and if acted upon in practice, likely to lead to very serious and dangerous results.

It must be remembered that this view of Morris represents the pre-roentgen period, and for that reason does not carry as much weight as it might. If the question as to whether or not renorenal reflex pain ever occurs rests on no more convincing evidence than that furnished by the literature antedating the period of the X ray, cystoscope, and ureter catheter, I am quite sure that the verdict must be "not proved."

It is interesting in going over the literature

to find that many authors accept, as a matter of fact, the existence of renorenal reflex pain, call attention to its frequency in nephrothiasis, and point out that it may lead one into error in exploring the wrong kidney, but they do not give any illustrative cases from their own experience. Albarran states: "One observes certain patients who suffer on the side opposite the lesion; reflex renorenal. He (Guyon) has demonstrated this in a large number of cases. In certain cases the pain persisting upon the healthy side has led to an error in diagnosis and Godlee was led to do a nephrotomy upon the healthy organ." Leguen says "There are cases of renal calculus in which the calculus produces subjective disturbances referred to the healthy kidney, this is one of the manifestations of renorenal reflex. In examining by bimanual palpation the kidney containing the calculus one sometimes sees the patient manifest sudden pain on the opposite side. This fact is of great importance as the surgeon may be led into the error of incising the healthy kidney as was done by Godlee."

Israel in his monograph speaks of the occurrence of renorenal reflex pain in the following language: "Ja, es kommt vor dass eine einseitige Steinverstopfung mit einem contralateralen Schmerzanfall beginnt, obwohl die Niere und Ureter der schmerzenden Seite frei von Steinen sind. Dieses von Albarran berichtete Vorkommnis veranlasste einen Eingriff der nicht occludirten Niere, an welcher als Ursache der Tauschung nur eine congestiv Schwellung ohne Stein gefunden wurde."

Kapsammer evidently accepted renorenal reflex as a fact. To quote "The pain can, furthermore, appear in the side opposite to the kidney bearing the stone, and when this kidney is enlarged (compensatory hypertrophy) it may be the one to which the operation is directed as happened in one case of Morris'. Moreover, without hypertrophy of the kidney the wrong one may be subjected to surgical attack on account of pain referred to the contralateral side, renorenal reflex pain of the Guyon school."

As a matter of fact the number of cases

scattered through the literature is small. The more recently reported cases naturally have been much more carefully studied and are, consequently, of greater importance in their bearing upon the question under consideration. The cases I have succeeded in finding are as follows:

David Newman,¹ reporting three additional cases makes the following comment: "In the *Glasgow Medical Journal*,² I tried to show that my experiences led me to believe renorenal reflex pain is a fact which must be accepted and in proof of the opinion I cited the following cases, one under the care of Mr Maylard, a second published by E. Owen, and a third personal case. In addition I have three others which demonstrated beyond a doubt that renorenal reflex is a fact which must be accepted."

Maylard's Case Patient aged 38, suffered a nagging pain for six months in the right iliac region. The attacks lasted 24 hours and caused vomiting. He had four attacks of acute iliac pain. Following one of these attacks blood and albumin was found in the urine. He never had had any frequency. The right kidney was explored but no stone was found although a catheter was passed down the ureter. There was suppression and death. Post-mortem examination showed the right kidney previously explored to be healthy and the left to contain a calculus the size of a pea in one of the upper calyces.

Edmund Owen's Case The pain was limited to the right side. The right kidney was explored with negative results. Later a large phosphatic calculus was removed from the left kidney (400 grams). Owen comments as follows: "I am well aware that it is not a very unusual occurrence for a surgeon to operate upon the wrong kidney in his search for a stone, but I do not think a more conspicuous instance than this of the untrustworthiness of the subjective symptoms of pain in renal calculus is likely to be forthcoming. Subjective signs are proverbially untrustworthy through the whole range of surgery, but in the case of the kidneys, which have drawn their nerves blindfold from the epigastric pool it is small wonder if, in the absence of subjective signs, the patient and surgeon are sometimes led by them to make mistakes."

Newman's Case 1 The patient, a male aged 58 years, has had dull pain in the left lumbar region for the past seven years with acute attacks of renal colic at intervals of 2 or 3 months. The attacks came on after exercise and were succeeded by hæmaturia. Cystoscopic examination during the attacks showed

blood from the right side only. This was observed on several occasions. Exploration of the right kidney advised but the patient refused as he was convinced the trouble was on the left side.

Newman's Case 2 Female, 25 years old, had suffered left renal colic attacks covering a period of 5 years. Cystoscopy showed blood from the right side. An X-ray examination showed a stone shadow in the right pelvis after four futile attempts. Right nephrotomy, recovery, and relief of all symptoms.

Newman's Case 3 History of right renal pain for a period of eighteen months. After several attempts a positive stone shadow was obtained on the left side. Left nephrotomy was done and a stone removed. Recovery and relief of all symptoms followed.

Newman's Case 4 The history of the patient is given in considerable detail. It is particularly interesting that the underlying cause was non-calculeus pyonephrosis. The pain was always referred to the left side. Nephrotomy and drainage of the right pyonephrotic sac was followed by a cessation of all pain.

Rumpel³ reports the following case:

A married woman, aged 35, suffered with an attack of left sided colic in the sixth month of pregnancy. After the birth of the child hæmaturia occurred, accompanied by a dumb pain in the left side. A diagnosis of tumor of the left kidney was tentatively made. Cryoscopy indicated kidney insufficiency. X-ray examination showed a stone shadow in the right kidney. Ureter catheterization gave evidence of nephritis on both sides, more marked on the left. Right nephrolithotomy freed the patient from all pain.

Victor Blum contributed a paper on, "Die Bedeutung der renorenalen Reflexen fuer die Pathologie und Diagnostik der Nierenkrankheiten," which appeared in the *Wiener klinische Wochenschrift*.⁴ In this paper Blum reports three personal observations of renorenal reflex pain.

CASE 1. Female, age 54, suffered for six years with attacks of renal colic, the pain radiating to the bladder, and accompanied by hæmaturia. These attacks were separated by intervals of weeks or months. The pain was always on the left side. The last attack occurred just before the patient came under observation, accompanied by anuria for several hours, and followed by hæmaturia on exercise.

The left kidney descended, the lower pole at the level of the crista ili, not painful and not enlarged. The right kidney was palpable below the costal border and on deep inspiration the whole surface could be felt. On deep pressure over the right

¹Lancet Lond 1900 : 1111

²Vol. iv 103

³Fortchr u d Geb d Roentgenstrahlen Hamburg 1904 : 1

Quote d by Josephson

⁴1897 No 40 1205

kidney pain was regularly produced in the left kidney similar to that during the attacks of colic.

Cystoscopy Cystitis granulosa fundi Both ureters normal with cloudy, bloody urine escaping from the right side.

Ureteral catheterization. Right—light, turbid, bloody urine, containing albumin; sediment contained numerous red cells, leucocytes, epithelium and granular casts. Left—clear, amber urine, free from albumin, sediment contained few red cells and leucocytes but no kidney elements.

X-ray examination of both kidneys. Left negative, right two stones, one the size of hazelnut, the other the size of a pigeon egg. *Operation:* right retroperitoneal pyelolithotomy. Several months after the operation there was sudden pain in the left kidney region, subsiding with warm applications. Subsequent cystoscopy and X-ray examinations gave negative results. No hematuria. Since operation the patient has remained perfectly well.

Case 2. Female, age 47. Two years before, the patient suffered slight attack of colicky pain in right hypogastric region lasting several hours. For 6 months she had similar attacks on the left side, no hematuria, no gravel. The right kidney pole was a hand's breadth below the costal border and was not painful. The urine was cloudy, with a trace of albumin, there were leucocytes, red cells, and hyaline casts.

Cystoscopy showed diffuse cystitis. *Ureteral catheterization:* Right, urine cloudy, alkaline, with trace of albumin. Left, clear, acid, albumin negative. X-ray examination. Right, stone shadow size of walnut, left, negative. *Operation,* right posterior pyelotomy.

Subsequent history. At times pain always referred to the left side. Recent X-ray examination and ureter catheterization show normal condition. After lavage of right kidney pelvis with 5 per cent silver nitrate solution all pain disappeared.

Case 3. Male, age 35, for three years suffered with attacks of kidney colic and hematuria referred always to the left side. Cystoscopy showed a calculus the size of a hazelnut in the opening of right-ureter. X-ray showed a stone shadow the size of pea in pelvis of the right kidney. Left side was negative. After passage of calculus the patient was absolutely free from pain and would not submit to further surgical interference.

Blum states further, that in addition to nephrolithiasis, there were also cases of unilateral renal tuberculosis and unilateral tumor under observation, in which pain was referred to the opposite kidney which was found healthy. Even after extirpation of the diseased organ the pain remained which could be explained only as renorenal reflex from the kidney stump. By all the methods of clinical examination the kidney in which the pain was located was found to be entirely healthy.

The most recent paper which I have been able to find is one by Josephson.¹ Josephson considered both renorenal reflex pain and reflex anuria. He reports in detail a personal observation of reflex pain which he claims is the most carefully and thoroughly studied case so far recorded.

Female, age 52, gave a history of attacks of abdominal pain dating back sixteen years (1894). Three years after onset she consulted Professor Lennander who made a diagnosis of stone in the right kidney and performed a right nephrotomy without finding a stone. Five weeks later the pains recurred. During one of these attacks, with pain referred to the right side and with an elevation of temperature, appendicitis was suspected, but under observation in the hospital this diagnosis was abandoned and the trouble was considered to be "digestive." During the past several years the attacks of pain have averaged only one or two attacks a year and it is always referred to the right side. Trouble in the left kidney was never suspected as shown by the fact that in 1909 her physician sent her for an X-ray examination of the right kidney only, and this showed only an enlarged and descended kidney. The patient was referred to Josephson for cystoscopy and ureter catheterization.

Cystoscopy. Bladder and ureters normal. *Catheterization.* Right—abundant clear straw urine, no albumin and no sediment. Left—light, turbid urine, albumin strongly positive. Sediment contained pus and blood. An X-ray examination showed three stones in left kidney, right, negative.

Operation. Left nephrectomy. The kidney consisted in a large part of a fibrous sac with little secreting substance. The stone was composed of phosphates with a mixture of calcium carbonate. The patient remained well for a year after operation or up to the time of the report. There was no return of the pain and the quantity and character of the urine remained normal.

Harnisch, quoted by Josephson, reports four cases with symptoms on one side and a stone shadow in the opposite kidney. In only one case was the diagnosis confirmed by operation and relief of all pain. Similar cases are reported by Forssell.

We know perfectly well that the pain produced by a stone in one kidney may radiate to the opposite side. This is commonly observed. It is also stated in the literature on nephrolithiasis that such pain is commonly referred entirely to the other side. This we believe is, on the contrary, far from being commonly observed. But that such complete transference of pain does occur, true

renorenal reflex pain, I believe we must admit from the evidence furnished by the observations recorded. While the earlier reported cases are open to criticism on the ground of incompleteness, according to the requirement of our present standards and methods of investigation, this objection cannot be applied, for example, to the observation of Josephson, Blum, Newman, Maylard, Owen, and the case above recorded. It may be added further that such a careful observer as Thompson Walker, without detailing his observations, sums up his experience as follows "The most important reflex pain is that in which pain is referred to the second kidney (renorenal reflex). I have seen two cases where the referred pain was present without pain in the kidney containing the calculus, and there are a few similar cases on record."

From my own experience and a study of the literature, I believe the following conclusions are justified and well founded

1. The symptom of pain arising from disease in one kidney may be referred entirely

and completely to the opposite side, the latter organ being healthy so far as we are able to ascertain by our present methods of examination. In the absence of any demonstrable lesion either within or outside of the kidney sufficient to account for such localization of symptoms we are justified in assuming the pain to be reflex — renorenal reflex pain.

2. Cases of renorenal reflex pain are rare. Only a relatively small number have been reported in detail.

3. The importance of this phenomenon, from the standpoint of diagnosis, is not as great as it once was. Errors in diagnosis are not so apt to occur from misleading subjective symptoms since the employment of more accurate means of examination, X-ray, cystoscopy, ureter catheterization, and renal functional tests has become more general. The occurrence of this phenomenon, however, emphasizes the importance of a thorough and complete pre operative examination of every case of suspected renal calculus.

THE THYMUS AND ITS TUMORS

REPORT OF THREE CASES OF THYMOMA

By JAMES EWING, M.D. NEW YORK

NO group of tumors has more successfully resisted attempts at interpretation and classification than those of the thymus. The problems involved include those which have complicated the embryological and histological study of the gland, and added difficulties arise from the comparative rarity and considerable diversity of the tumors and from the somewhat imperfect knowledge of the general pathology of the thymus.

A short résumé of the knowledge of the origin and structure of the gland will facilitate the interpretation of its tumors (Hammar)

ANATOMY

The thymus is a paired organ arising from evaginations of the third branchial clefts (Thymus III). Its anlage is contiguous

with that of the parathyroids arising from the same clefts, a relation which explains the occasional presence of parathyroid alveoli in the thymus, as well as the rare association of thymus tissue with parathyroid in the thyroid gland. A second portion of the thymus arises from the fourth cleft where it holds the same relation to the parathyroid developed from this cleft (Thymus IV). From these four sources the growing endodermal epithelium coalesces to form a four-lobed fetal organ which with the descent of the heart becomes drawn out in an elongated double pear shape. In Hammar's early fetal models the stems stretch from the lateral lobes of the thyroid down below the sternal notch where the main mass of the gland develops, the stems disappearing. This mode of origin only partly explains the occurrence of acces-

sory thymus lobes beside and below the thyroid (Erdheim) and laterally in the neck. Sharp describes a large accessory thymus extending from the anterior border of the trapezius behind the sternomastoid and clavicle.

The fully developed organ consists of a stroma and reticulum, parenchyma, and capsule. The supporting stroma is chiefly found in the network of arterioles, capillaries, and venules to which is confined practically all of the connective tissue within the organ. The finer stroma is a derivative of the original epithelium of the gland which becomes elongated into a fine reticulum in the meshes of which lie the parenchyma cells. This reticulum has nodal thickenings or syncytia, and may be stretched into fine fibrils. By accumulation of its cells in the medulla are formed concentric groups of flat cells (Hassall's corpuscles) with which the reticulum is directly continuous, while on the periphery in many foetal glands the epithelium appears in groups and cords in cubical or cylindrical form. Hassall's corpuscles are therefore not remnants of foetal epithelium but collections of adult reticulum cells. In the medulla the reticulum is far more abundant than in the cortex.

The parenchyma cells have the appearance of small lymphocytes from which

lymphocytes, the development of other lymphoid organs by the inwandering of lymphocytes, and the behavior of these cells in pathological conditions. Most observers, including Maximow, Hammar, and Wiesel, consider the thymus an organ with peculiar reticulum of epithelial origin infiltrated by lymphocytes. Yet the organ never assumes either in structure or functions the position of a simple lymphoid organ. In many conditions it fails to participate with other lymphoid organs in systemic diseases (Hart).

In addition to the lymphocytes other cells are often seen in the thymus. Shaeffer observed many plasma cells derived from the lymphocytes in the involuting gland, and with these may occur eosinophile cells and mast cells (Maximow). Watney describes giant phagocytes. Myoid cells with cross striation are scanty but very constant derivatives of the epithelium. Wasutatschkin however, considers that they are derived from the muscle-cells in the capsule. The formation of red cells appears to be limited to lower animals but evidences of the formation of leucocytes are frequently observed in man.

The efforts to establish the thymus as a gland of internal secretion and a unit in the chromaffin system are reviewed by Wiesel.

REAL PATHOLOGY

accidental variations it is extremely difficult to establish the existence of a hypertrophy unless of very marked degree. Involution takes the form chiefly of fat invasion of the parenchyma with persistence of many Hassall corpuscles. Simple hypertrophy of the thymus occurs in infants in which the enlarged gland exerts, at least in part, a mechanical effect in fatal thymic asthma by compression of the trachea. The structure of these glands is usually normal. In status lymphaticus the thymus usually exceeds the normal weights for the age and weight of the patient, and at times the excess is very marked. In Graves' disease, thymus hypertrophy is nearly constant and often marked. In all of these conditions the hypertrophy is due to lymphocytic hyperplasia, and does not reach the grade of a neoplasm. In aberrant thymus tissue the hyperplasia has at times been very active as in Sharp's lymphadenoma of a cervical thymus. Hyperplasias interpreted as lymphadenomata are described by Rolleston, Edmunds and McKenzie, Pepper and Stengel, and HeKtoen. In these cases the organ was several times the normal size, the capsule was intact, the medulla largely obliterated, and Hassall's corpuscles widely scattered. Tarozzi described as simple hyperplasia a very large encapsulated tumor occupying all the anterior mediastinum in a boy of 18 years.

Proliferation or more correctly increase in number of Hassall's corpuscles occurs in Graves' disease (Soupault) and in hæmophilia (Acland).

Exfoliation of very numerous large reticulum cells in the involuting thymus has been described by Lochte in gangrenous gingivitis and in leukæmia. The thymus is said to participate with other lymphoid organs in the changes of leukæmia, pseudoleukæmia and granuloma malignum, but Schridde failed to find any changes in this organ in leukæmia and pseudoleukæmia. Hahn and Thomas collected several cases of thymic tuberculosis.

Cysts form in the thymus from several sources (Pigache, Beclere, Hueter).

1 The epithelial canals of the embryonal thymus may persist and form one or several

small or large cysts in or along the horns of the gland. They are especially frequent in syphilitic infants. Each lobe of the organ may be converted into a large cyst (Bednar). Pollosson and Piery describe a congenital multilocular cyst of a cervical thymus extending from behind the sternum to the mid-carotid region. It was lined by flat pavement cells. In a sclerosed and luetic thymus in a man of 25 years Hueter found general cystic alterations. The cysts were lined by flattened cells, filled with mucoid and lipid material, and into many of them grew polypoid masses of thymus tissue. The origin was attributed to persistent epithelial cell groups. Westernak recognized a mediastinal cyst lined by ciliated epithelium by means of thymus tissue in the wall, and he attributed its origin to the thymus duct. The demonstration of lymphoid tissue and Hassall's corpuscles in the wall aided Funke in the recognition of a thymus cyst in the thyroid.

In Graves' disease Soupault describes multiple cysts lined by columnar epithelium. In a man of 69 years he found a thymus 15 cm in length, hyperplastic above, but in the lower half a diffuse overgrowth of epithelial cells and small cysts filled with mucus.

2 Dermoid cysts, of which Hare has collected nine cases, may arise from portions of the ventral ectoderm, or from the branchial clefts. Rolleston described a compound cyst with adenomatous structures resembling Lieberkuhn's follicles and areas of cartilage and sarcoma.

3 Invasion and distention of Hassall's corpuscles by lymphocytes is of common occurrence and many small cysts may form throughout the gland by degeneration of these wandering cells. Chiari showed that Dubois' abscesses consist of distended corpuscles filled with lymphocytes. The lining of these corpuscle cysts is of cubical or flat epithelium. All these cysts are regarded by Ribbert as derived from persistent embryonal tubules.

4 Cystic lymphangioma is described by Seidel in an infant of 2½ years. The entire organ was the seat of many small cysts filled with fluid blood and lined by flat endothelial cells.

PRIMARY TUMORS OF THE THYMUS

Primary tumors of the thymus are probably not as rare as the scanty reports would indicate. Rubaschow collected 69 cases but questioned the thymic origin of many. The age of incidence of 33 sarcomata was: before 25 years, 18 cases; from 25 to 40 years, 8 cases, more than 40 years, 7 cases. Carcinomata occur in later years and usually after 50. Steudener found a large lymphosarcoma in an infant of one year. While Virchow believed that thymic hypertrophy led to tumor growth, Bartel's statistics do not show that cases of status lymphaticus are especially prone to develop thymic tumors. Lisenstadt's case gave a history of trauma. The age of incidence and the usual course of involution strongly suggest that thymic carcinoma is affected by disturbances in the natural process of involution.

The origin of sarcomata seems closely connected with that of other lymphosarcomata and not a few of these cases show marked resemblance to, or practical identity with, granuloma malignum. Analogy suggests that the peculiar reticulum cells of the thymus may at times respond to infection by inflammatory and eventually neoplastic overgrowth.

CLASSIFICATION

Thymic tumors fall into two main groups: (1) Lymphosarcoma or thymoma, composed of a diffuse growth of round, polyhedral, and giant cells. The chief source of this tumor is probably the reticulum cell, but lymphocytes are often present in abundance, and (2) carcinoma arising from the reticulum cells. To these may be added very rare and somewhat questionable cases of tumors attributed to the stroma and called (3) spindle cell sarcoma or myxosarcoma.

Owing to the uncertainty which still surrounds the nature of the thymic round cells the term "thymoma" has been suggested by Thierloix and Debret, Simmonds, and others, for tumors of this origin, while Schröder employs the phrase "malignant thymus tumors."

The exact origin of the so called lymphosarcomata of the thymus remains undetermined. My own study of several cases has led to

the conclusion that the thymic round-cell tumors differ from other round-cell tumors of lymph nodes, that the reticulum cell is here the chief or sole source of the tumor the lymphocytes being largely passive, that these tumors form a malignant subdivision of granuloma malignum. If these conclusions are correct the term thymoma deserves recognition.

1. *Lymphosarcoma*, or thymoma is the most frequent form of thymus tumor. The tumors occupy the anterior mediastinum in the position of the thymus, and usually extends from the sternal notch as high as the thyroid down to the diaphragm. Many authors have questioned the diagnosis of thymic origin based on the location of the tumor but the objections seem to apply chiefly to clinical diagnosis. There is little difficulty in distinguishing thymic tumors at autopsy from tumors of mediastinal lymph nodes, lung or sternum. They usually surround and compress the trachea, bronchi, pericardium, and great vessels. Both by compression and less often by invasion of vessels and passages they cause death by asphyxia and venous obstruction which may increase gradually or supervene suddenly. The more rapidly growing tumors may be soft but as a rule they are found to be remarkably dense from diffuse fibrosis. The soft tumors may be vascular and hemorrhagic while the firm growths exhibit a characteristic lobulation from dense fibrous septa. Rarely areas of softening and cyst formation are observed. In many cases the tumors exhibit a characteristic creamy yellow or lemon color.

A strict encapsulation within the mediastinum has been a notable feature in some histologically malignant growths, but the more malignant forms regularly become adherent to surrounding organs and invade pleura, lung, pericardium, walls or lumina of vessels and trachea. The bronchial and cervical nodes are frequently invaded. The axillary nodes may be enlarged and in Gabeke's case the invasion of nodes was very widespread. Occasionally there are metastases in the organs, spleen, liver, adrenal, pancreas, and kidney (Zimniewicz). Perforation of the

chest-wall has occurred in several cases and was the first localizing symptom in a case I have recently observed (Seeböhm, Zniniewicz, Le Tulle). Fracture of the humerus from bone-marrow metastases is recorded by Zniniewicz, and infiltration of the orbits, brain and other organs, by Meigs and de Schweinitz.

The structure of these tumors varies greatly. Exactly the same difficulties are encountered in their histological classification as one meets with tumors of lymph-nodes. In one group the structure resembles that of an infectious granuloma of the type of Hodgkin's disease. The tissue presents lymphocytes, plasma cells and larger polyhedral cells, irregularly distributed. Several cases of this type have been recorded with emphasis on the presence of many large polyhedral or giant cells (Ertmann, Weigert and Laquer). These large cells must be derived from the reticulum. When they become very numerous the lymphocytes largely disappear and the tumor may be classed as a carcinoma, as has commonly been done by French writers (Le Tulle). In another group the reticulum cells are said to be missing and the tumor is composed of a diffuse growth of small round cells (Le Tulle Stockert). These tumors have not been distinguished from other lymphosarcomata, but it does not appear that any definite effort has been made to do so. The existence of a pure lymphocytoma of the thymus apart from leukaemia does not appear to have been established. The blood-vessels may be very numerous and in some cases cells of medium size may form sheaths about the vessels. When the perivascular arrangement becomes very marked and lymphocytes are scanty the diagnosis of endothelioma or perithelioma may be suggested as in the cases of Hahn and Thomas and Mandelbaum and Celler. It seems highly probable that these cells arise from the reticulum producing an analogue of perivascular endothelioma of the lymph-nodes.

In the same manner may be explained the mixed tumors described by Gabeke and Schneider, who found round and spindle and many giant cells in their tumors, all of which may readily be derived from the reticulum.

On close analysis the round-cell tumors of the thymus are found to differ in structure from the round-cell tumors of lymph-nodes. The lymphocytes are scanty. The chief cell showing mitosis is often polyhedral, with acidophile cytoplasm, vesicular nucleus and well developed nucleoli. They often cling to the walls of numerous small capillaries where they assume a cubical or even cylindrical form. They frequently produce abortive Hassall corpuscles. The giant cells are of two main types: (1) pale staining reticulum cells with irregular outlines distended with vacuoles and red cell detritus, and (2) myeloid giant cells with opaque acidophile cytoplasm and many vesicular nuclei. These giant cells differ from the smaller giant cells of lymphatic Hodgkin's disease. The marked fibrosis suggests the desmoplastic property of carcinoma.

2 *Thymic carcinoma*. In many cases the main tumor-cell appears in the form of pavement, cubical, or rarely cylindrical epithelium and the growth must be classed as carcinoma.

The gross anatomy of thymic carcinoma is identical with that of the hard thymomata of round cell type. Although metastases may occur, it is notable that the invasion of surrounding organs is less active than is usual with a distinctly carcinomatous tumor. An aberrant thymic carcinoma containing lymphoid tissue and numerous bodies resembling Hassall's corpuscles was observed in the thyroid by Achard and Paiseau.

The structure in typical cases presents coherent sheets, cords and columns of large flat, or polyhedral cells, lying in dense connective tissue. Hornification is absent, but concentric layers of flat cells may form structures resembling Hassall's corpuscles (Thirollet, Debret, Paviot, Gerest). In other cases the pavement characters are less evident and the cells are chiefly cubical and form alveoli. Le Tulle and Ambrosini found accumulations of mucus in the spaces of an alveolar carcinoma. In many cases both round cells and epithelium participate in the tumor process and the authors speak of the growth as carcinosarcoma or adenosarcoma. Thus in Rubaschow's case the main mass was composed of round cells in which lay many foci

of flat epithelium forming pearls or surrounding blood-vessels. Giant cells of a variety of forms are frequently present.

3. *Thymic sarcoma.* Although it has been commonly assumed that various spindle-cell or alveolar or perivascular tumors arise from the connective-tissue stroma of the thymus, this origin has never been fully traced and there are strong grounds for concluding that all the so-called spindle-cell sarcomata and endotheliomata are varieties of thymoma. Congenital myxoma, 10 x 18 cm. in dimensions, weighing 182 gr., containing lymphocytes and Hassall corpuscles in the tumor-tissue was observed by Caso in an infant of 2½ months, and a similar case is described by Winogradoff.

Interpretation of thymomata. The foregoing review of the structure of thymus tumors reveals extreme confusion in the nomenclature employed by different authors, great difficulty in establishing sharply defined varieties, and the existence of transitional forms connecting the two types. The great polymorphism of the cells noted by Ambrosini has been emphasized by later writers as the chief characteristic of thymic neoplasms and has led to the use of the term thymoma. It is significant that the carcinomata have been recorded almost entirely by French observers while practically all the German reports are of sarcoma. Yet Le Tulle and Ambrosini describe as carcinoma, tumors which have many of the features which Ertmann and Zniniewicz have designated as sarcoma. It is also clear as in Dansac's, Hauser's and Rubaschow's cases that many tumors present an overgrowth of both reticulum and parenchyma cells. A full survey of the structural variations reveals at one extreme a mixed process involving lymphocytes and reticulum cells, with giant, plasma, and eosinophile cells producing a structure nearly identical with Hodgkin's granuloma. At the other extreme are nearly pure tumors of rounded or epithelial reticulum cells; i.e., lymphosarcoma and carcinoma. Exactly similar relations exist between tumors of lymph-nodes, including Hodgkin's granuloma

the conclusion is reached that majority of thymus tumors and the mixed growths represent infectious or particular forms of cell origin arising on the basis of an infectious process. Detailed evidence supporting this is presented in the writer's study of thelioma of lymph-nodes. This point of view offers a simple explanation of the great variety of structural forms of thymus tumors present.

In a series of cases of Hodgkin's disease the granulomatous process has shown properties both in local aggregation and in the production of metastases. Cases are recorded by Yamasaki, Cl Welch, Symmers, Karsner, and Be most of these cases it is stated that tumor was mediastinal and occupied a large portion of the thymus, while the structure presented a diffuse growth of cells like lymphocytes and many giant cells of type. In the report of Symmers' case in this laboratory, a thymic origin is suggested. I have re-examined various of this tumor and find in it all the features of thymoma including Hassall's corpuscles, polyhedral reticulum cells, and myeloid cells. In the light of this and other seems highly probable that the mediastinal Hodgkin's disease of the above writer is a thymic tumor which should be distinguished from other forms of Hodgkin's disease. It owes its malignancy to its origin from reticulum cells of the thymus.

CLINICAL COURSE

Many thymus tumors are highly malignant and prove rapidly fatal from local extension but the actual duration is difficult to determine. Ambrosini's five cases were in from two to nine months. The most rapidly growing tumors are usually cellular and vascular. In one of Zniniewicz's cases lasting ten weeks there were metastases, while in Ambrosini's two months' duration the extent was local, and Ertmann's tumor of two months' duration was vascular, contained v

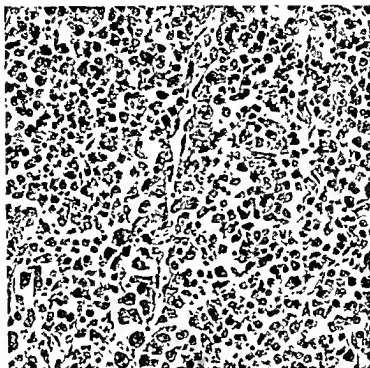


Fig. 1. Case 1. Diffuse malignant thymoma. Polyhedral cells attached to capillary wall and growing diffusely. Scanty lymphocytes.

tases were limited to the pleura. The tumor described by Hahn and Thomas reached dimensions of 26 x 18 x 19 cm in one year.

Constitutional symptoms suggesting a sympathetic disturbance of the chromaffine system are not observed but Gabcke records for his case that the adrenals were very large and the skin pigmented. In a notable group of cases thymic tumor has been associated with myasthenia gravis (Oppenheim, Weigert and Laquer, Buzzard). Of 45 cases of myasthenia gravis Mandelbaum and Celler found thymus lesions recorded in eleven. The thymic tumor has usually shown the structure of "lymphosarcoma" mingled with epithelioid cells. In Hun's case the epithelioid cells were abundant but showed no tendency to form Hassall's corpuscles while plasma cells, eosinophils and focal hemorrhages are often present. Mandelbaum and Celler found a tumor composed of small concentric groups of polyhedral cells while the numerous vessels were sheathed with lymphocytes and sur-

rounded by tumor cells. The tumors are usually of moderate size, and in several cases the lesion was regarded as simple hyperplasia (Link, Burr, Buzzard).

Throughout the skeletal muscles and often in the organs are found foci of lymphocytes with varying numbers of polynuclear leukocytes and eosinophilic plasma, or epithelioid cells. Weigert and Laquer regarded these lesions as metastatic foci, while others consider them as of local inflammatory origin. Their occurrence favors the view that some thymic tumors are manifestations of an infectious granuloma.

REPORT OF THREE CASES OF THYMOMA

CASE 1 (6470). *Thymoma with extensions throughout neck, mediastinum, and axilla. Acute febrile course, duration seven months. Suppuration and necrosis. Death from asphyxia. No distant metastases. Tumor composed of round, cubical and cylindrical reticulum cells.*

Clinical abstract. A C, female, 19 years. Family history negative. Had scarlatina in childhood. One year ago noticed slight edema of feet. Illness

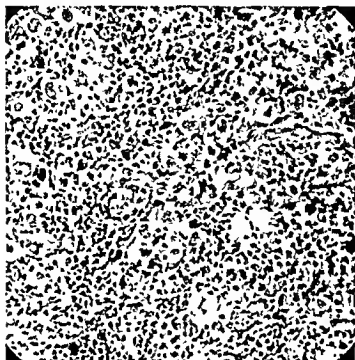


Fig. 2. Case 2. From presterneal mass. Abundant giant cells, many polyhedral reticulum cells, scanty lymphocytes.

began in August 1914 with a swelling of left side of neck, which after reaching the size of an egg largely regressed. The swelling was referred to two decayed molar teeth which were extracted and found to be the seat of root abscesses. The swelling soon recurred and the whole right side of neck from ear to shoulder became much swollen. There was irregular fever and loss of weight. October 15, left side of neck became involved and in December the right axilla was swollen. December 30 an abscess in the right side of neck was opened and some tumor tissue removed.

On admission to the General Memorial Hospital January 23, 1915 the patient presented very extensive swelling of both sides of the neck from ears to shoulders and involving both axillae, especially the right, where the tumors were bulky, diffuse and ulcerating. There was edema of the face and slight exophthalmos of right eye. The neck was immovable and pressure on the trachea and larynx caused constant dyspnea. The temperature ran from 99 to 103°F. Percussion revealed a tumor mass behind sternum and much restriction of respiration. The other organs and lymph nodes were negative. Exitus February 9.

Autopsy. February 10, 1915. Body moderately emaciated and anemic. A bulky, diffuse tumor mass extends from ears over both sides of neck

over right shoulder and into right axilla. Ulcerating areas present in neck and over the shoulder. The right humerus is displaced by bulky tumor masses in axilla and considerable masses appear in left axilla. The right breast is swollen and invaded by tumor tissue. On dissection the tumor is found to extend from the base of the skull tightly incasing the pharynx, larynx, trachea and vessels to the upper border of the pericardium and root of lung. In the region of the thymus it is very dense and fused with all adjoining structures and with the sternum. The larynx is tightly compressed by firm masses of tumor which surround thyroid cartilage, sinuses, tonsillar regions and base of tongue. Many tumor nodules protrude beneath the masses but the surface epithelium is everywhere intact. The lung is not involved but the pleura is invaded from the axilla through the third intercostal space. The right lobe of the thyroid is diffusely invaded. The tumor tissue is firm, elastic, lobulated, of peculiar lemon yellow color and except in suppurating areas, free from necrosis. The bronchial lymph nodes are invaded but there are no extensions below this point and no metastases.

Lungs congested, edematous; liver shows slight cloudy swelling, spleen slightly enlarged, soft, follicles invisible. Kidneys show slight irregularities in cortical markings, adrenals normal, gastro-

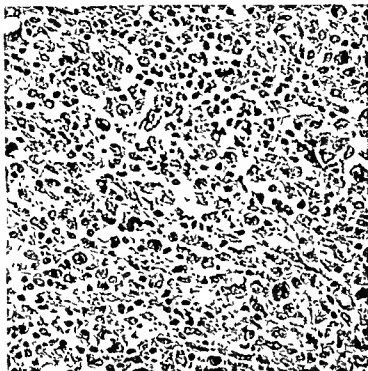


Fig. 3 Case 3. Coherent network of large fusiform and polyhedral reticulum cells fibrosing at edge. Scanty lymphocytes.

intestinal tract and genital organs normal, no traces of suppuration were found in upper or lower maxilla.

Microscopical structure. The tumor has the general structure of a large cell lymphosarcoma but is much more vascular and presents much more fibrous tissue than a lymphosarcoma. On closer study the prevailing cell is found to be a medium sized polyhedral or cubical cell of epithelial character. The nuclei are large and vesicular, the nucleoli prominent and the cytoplasm opaque and acidophile. The arrangement is not diffuse, but the cells are applied to the walls of numerous capillaries in cubical or cylindrical form and often in palisade fashion or yielding a pseudopapillary structure (Fig. 1). Mitoses are very numerous. Scattered lymphocytes appear throughout the section. Giant cells appear in two forms. One resembles the myeloid giant cells with bulky, multi-lobed nuclei. The other is a large pale vacuolated cell with shrunken nucleus and containing englobed detritus. It may be traced to the chief cells. The whole tumor is subdivided into many small lobules by rather dense fibrous tissue and the thickening of many capillary walls adds to the density.

Epicritical. The chief features of interest in this case are the acute febrile course and the early simulation of an infectious pro-

cess following alveolar abscess, the very rapid extensions during the later course, the absence of metastases, and the characteristic structure. The diagnosis of a thymic origin is based on the gross anatomy which showed the densest portion of the growth in the region of the thymus, on the mode of extension peculiar to thymic tumors, and on the structure. The tumor proved to be not a lymphosarcoma but a peculiar growth of epithelioid cells and giant cells as observed in other thymic tumors. The absence of Hassall corpuscles may be referred to the rapid growth of the tumor which was distinctly neoplastic and malignant.

CASE 2 (6406). *Perforating sternal tumor originating in the thymus. Enlargement of nodes in both axilla and behind clavicle. Duration 2 years, active course four months. Regression under X ray treatment. Structure of tumor giant cell thymoma.*

Clinical notes. Mr. J. N., age 32, plasterer. A brother died of pulmonary tuberculosis. Typhoid fever at 8 years. Had severe colitis shortly before beginning of present illness. Has had several

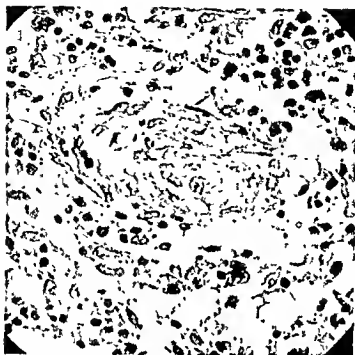


Fig. 4. Case 3. Hassall corpuscle forming in reticulum. Polyhedral tumor cells attached to reticulum. Scanty lymphocytes.

attacks of tonsillitis. About January, 1913, noticed beginning tenderness at upper part of sternum and enlargement of lymph nodes in both axilla. These symptoms increased slowly but he continued at work. In July, 1914, he began to suffer from fever at night and the axillary nodes increased in size. Then was now a feeling of fullness in the chest and a tendency to cough while talking. In November, 1914, he became severely ill and was confined to bed with fever at times as high as 106°F . The sternum became more tender and a swelling appeared at the second and third interspaces. In December this swelling was incised and a portion of tissue removed for examination. On admission to the General Memorial Hospital January 7, 1915, the patient was somewhat emaciated, temperature running between 99 and 101°F . There was a fungating ulcerated tumor 3×8 cm. over upper portion of sternum. A soft clunged tumor mass appeared from behind the right clavicle. The nodes in both axilla were enlarged, those on the right side as large as a walnut. The cervical nodes were not affected but the inguinal nodes were slightly enlarged. The spleen was barely palpable. Percussion indicated the presence of a mass in the upper mediastinum and the X ray revealed a distinct shadow extending 14 cm. downward from the sternal notch and 13 cm. laterally.

Under heavy X ray treatment the ulcerating tumor healed and the enlarged nodes disappeared, the X ray shadow contracted, the patient greatly improved in strength and nutrition, the temperature became normal, and he was discharged to return regularly for observation.

The tissue removed from the sternal tumor presented a structure resembling Hodgkin's granuloma with excess of peculiar giant cells. The giant cells are large rounded or polyhedral with light staining cytoplasm, nuclei multilobed and hyperchromatic or multiple and vesicular, and with very prominent strongly acidophile nucleoli. They are larger than the giant cells of Hodgkin's granuloma and somewhat resemble the myelophagocytes of bone marrow. They are numerous and appear uniformly over the entire section. The derivation of the giant cells seems traceable to more numerous smaller rounded or polyhedral epithelioid cells which made up the bulk of the tissue. In some areas the smaller cells are exclusively present while other portions consist chiefly of giant cells. Both frequently show mitoses. The stroma is composed of small arterioles and capillaries with cellular walls along which the main tumor cells are often arranged as cubical or columnar epithelium. Throughout the section lymphocytes appear in moderate numbers. Necro-

sis appears in a few small areas, and also affects isolated giant cells (Fig. 2).

Interpretation. The existence of a large mediastinal tumor is clearly indicated by auscultatory and X-ray signs. The early perforation of the chest wall is a notable feature which has previously been observed by Le Tulle, Zimnicz, and Seeborn. The diagnosis of a thymic tumor is based not only on the physical signs but especially on the histological structure. The finer structural details differ widely from those of ordinary lymphocytoma or reticulum cell sarcoma, and accord closely with those of other cases of this series. The whole process presents the characters of a peculiar infectious granuloma rather than of a true neoplasm and in many respects resembles Hodgkin's granuloma. The prompt regression under X-ray treatment also suggests a granulomatous nature. Although the inguinal nodes were slightly enlarged there was no definite systemic involvement.

CASE 3 (3742). *Slowly progressive thymoma of granulomatous type, suggesting Hodgkin's disease in a subject of 50 years. Duration 2 years. Large very dense circumscribed mediastinal tumor. No metastases. Structure of cubical and polyhedral reticulum cells with Hassall's corpuscles and many peculiar giant cells.*

This case has already been reported by Symmers as a possible example of transformation of Hodgkin's granuloma into sarcoma. The possibility of a thymic origin was considered by Symmers and the later study of the case in the light of other cases and especially the demonstration of Hassall's corpuscles lead me to conclude that the tumor is a thymoma.

Clinical abstract. Patient female, 50 years, began to suffer pain in right shoulder in November 1908, which soon extended to left shoulder. Attacks of febrile jaundice and edema of legs were noted in March 1909. In November 1909 a variable swelling appeared above right clavicle. In May there was dyspnea and dry cough. July 1 a small tender mass appeared in left side of neck, soon followed by enlargement of right side of neck and right breast dilatation of chest veins and severe dyspnea. The chest was twice aspirated of clear fluid. The supraclavicular and suprasternal nodes were enlarged but the axilla remained free. With increasing dyspnea and general edema of right arm, chest and legs the patient succumbed, October 29, 1910. Duration total 24 months after appearance of cervical tumor, 12 months.

Autopsy revealed a firm lobulated lemon yellow tumor, 18 x 11 x 15 cm. in the upper mediastinum overlapping the pericardium, pushing heart down ward and incising the trachea and great vessels. Above, it invaded the lower pole of the thyroid. The trachea was slightly displaced to the left and its wall invaded for a length of 8 cm. by nodules

which extended to the submucosa and caused erosion of lining epithelium. The mass extended from sternum to spine but did not invade lung. No metastases were demonstrated. The general lymphatic system, spleen and bone marrow were unaffected and the other organs were negative.

The tumor was remarkably firm solid, resistant, and sharply defined, and on section exhibited many small lobules of rather uniform size surrounded by dense connective tissue.

Microscopical structure. The tumor presented the general appearance of Hodgkin's granuloma with excess of peculiar giant cells and unusual fibrosis. The chief cells were large with hyperchromatic nuclei, suggesting a transformation into sarcoma.

On analysis from the standpoint of thymoma characteristic features are revealed (Fig. 3). The chief cells are not large lymphocytes but cubical cylindrical polyhedral elongated and very irregular cells with vesicular nuclei and prominent nucleoli. Most of these form parts of a reticulum sometimes inclosing capillaries to which many of the cells are attached. In the meshes of the reticulum lie loose tumor cells and a uniform admixture of lymphocytes. The reticulum cells make the chief feature of the tumor and in places these pale cells form concentric groups resembling Hassall's corpuscles (Fig. 4). Giant cells are very numerous and of all sizes. They present large multilobed nuclei almost filling the cell body. They may be traced to the proliferating cells of the reticulum. Mitoses are very scanty. The tumor lobules are small or large and are surrounded by dense or cellular fibrous tissue which penetrates the lobules is continuous with the reticulum and gives the impression of a progressive sclerosis in a once more cellular tumor.

The diagnosis of thymoma is based on the form, location, density, circumscription and color of the tumor in the gross and on its microscopical structure. This structure differs notably from lymphosarcoma or Hodgkin's granuloma. As noted by Symmers its neoplastic characters are not pronounced. The chief cells are not round or lymphocytic nor do they resemble lymphatic reticulum cells but are cubical or elongated or even cylindrical. The reproduction of Hassall's corpuscles, while imperfect, is quite as complete as in many such bodies in the normal thymus. The tumor arises from the reticulum cells of the thymus while many lymphocytes persist in the process and contribute to the bulk of the tumor. The giant cells are also different from those of Hodgkin's granuloma. They are often very large, the cytoplasm is opaque and acidophile and nuclei are very hyperchromatic. The history and the indefinite neoplastic properties suggest that the process like Hodgkin's disease, was of infectious and inflammatory origin.

BIBLIOGRAPHY

- ALLAN, Good Path. Soc., XXXVI, 491.
 ACHARD, PASSEAL. Arch. med. exper. xv, 78.

- AMBROSIUS Thèse de doct., Par., 1894
 BARTLE Jahrb. d. Kinderh., 1906, lxxv, 259
 BEARD Anat. Anz., Jena, 19
 BRONAR Cited by Chauri
 BREITKE Deutsche path. Gesellsch., 1909, xiii, 264
 BELL Am. J. Anat., 5
 BREN Anat. Anz., Jena, 1900, p. 20
 BOWMAN and NICOLL Arch. Anat., 1907
 BURR McCARTHY Am. J. Med. Sc., 1901, cxi, 45
 BIZZARD Brain Lond., 1903, xxxv, 418
 CASO Gazz. d. osp. Milano, 1917, xlviii, 402
 CHARI Zentralbl. f. Path., xvi, 8
 CHARI Ztschr. f. Heilk., 1904, xv, 401
 HANSEN Soc. Anat., 1894, xlviii, 100
 EDMUND MCKENZIE Tr. Lond. Path. Soc., xlviii, 192
 JENSEN Inaugural Dissertation, Greifswald, 1907
 ERMANN Zeitschr. f. Heilk., 1903
 ERTSMANN Inaugural Dissertation, Jena, 1908
 LUKA Phila. Path. Soc., 1908, xl, 60
 GABLER Inaugural Dissertation, Kiel, 1907
 HALL THOMAS Arch. gén. de méd., 1907, i, 321
 HAMMAR Tr. Anat. Soc. Anat., No. 41
 HALL Cited by Rolleston
 HAYES J. Anat. & Physiol., 1901, xxxv
 HAYES Arch. f. path. Anat. (etc.) Berl. orig., 1
 HAYES Soc. Anat., 1901, lxxxi, 169
 HERTZ Internat. Med. Mag., 1909, i, 739
 HERTZ Ziegler's Beitr., 15
 HEN ALBANY Med. Ann., 1904, xxi, 28
 KARNER Arch. Int. Med., 1910, vi, 125
 KETTLER Arch. gén. de méd., 1906, li, 641
 LANK Deutsche Ztschr. f. Nervenh., 1902, xxi, 224
 LANGE Zentralbl. f. Path., 1901, p. 1
 MANDLBAUM and GUTER J. Exp. Med., 1908, i, 308
 MAXIMOW Arch. mikr. Anat., 1905, 325
 MILES DE SCHWENITZ Am. J. Med. Sc., 1904, cxvii, 193
 OPPENHEIM Dissertation, Myasthen. Paralyse, Berlin, 1901
 PAVLOV, GERASE Arch. méd. expér., 1896, viii, 609
 PEPPEL SCHEIDT Internat. Med. Mag., 1909, i, 739
 PICHOT, BRICARD Soc. Anat., 1901, lxxxi, 1
 PIERSON, PIERI Tr. med., 1901, p. 151
 PIERANT La Cellule, 10
 RIBBERT Frankl. Ztschr. f. Path., ii, p. 205
 RUFFET Compt. rend. Acad. sc., 1900, p. 148
 ROTTERDAM J. Path. & Bacteriol., Lond., 11
 ROTTERDAM Clin. J., 1898, xii
 ROSENTHAL Path. Soc., 1909
 KERNSCHMIDT Arch. f. path. Anat. (etc.) Berl., cxvii, 141
 SCHWENITZ Zentralbl. f. Physiol., xvi
 SCHWENITZ Inaugural Dissertation, Greifswald, 1912
 SCHWENITZ Path. Anat. (Arch. f. Zentralbl. f. Path., 1911, xii, 602
 SEYDOW Hamburg Staatsan., 1900
 SEYDOW Inaugural Dissertation, Leipzig, 1902
 STRAB Lancet Lond., 1907, i, 416
 SUMNER Ztschr. f. Krebsforschung, xii, 280
 SUTCLIFF Soc. Anat., 1907, p. 127
 SUTCLIFF Arch. f. path. Anat. (etc.) Berl., xlv, 411
 SUTCLIFF Inaugural Dissertation, Heidelberg, 1905
 STOLTE Anat. Beibl., 1907, xvi, 429
 A. STOLTE Arch. f. path. Anat., 1908, xvi
 SUMMERS N. Y. M. J., 1911, xlvii, 671
 TAPPEZ Zentralbl. f. Path., 1908, p. 154
 THOMPSON and DREXLER Arch. méd. expér., xii, 608
 WASTENHUIS Zentralbl. f. Path., 1911, p. 617
 WASTENHUIS Proc. Royal Soc. Med., p. 17
 WASTENHUIS and LANGE Neurol. Zentralbl., 1901, p. 394
 WELCH J. L. N. Y. Path. Soc., 1901
 WELCH Tr. Path. Anat., 1911
 WUNDERLICH Arch. Klin. d. pathol., 1907, iii, 41
 YAMAMOTO Ztschr. f. Heilk., 1904, v, 299
 ZIMMERMAN Inaugural Dissertation, Greifswald, 1911

THE PHYSIOLOGICAL METHOD OF TENDON TRANSPLANTATION

III. EXPERIMENTAL AND CLINICAL EXPERIENCES¹

By HIO MAYER, M.D. NEW YORK

EXPERIMENTAL EXPERIENCES

THE experimental basis of the physiological tendon transplantation was worked out in 1912 by the experiments conducted by Dr Henze and myself in the clinic of Professor Lange of Munich. These experiments showed conclusively that post-operative adhesions could be prevented by restoring the normal relationship between the tendon and the sheath.

I undertook further experimental work to test the efficiency of the fixation method outlined in the previous paper and thus to determine when it was safe to allow the transplanted tendon to function. I also wished

to trace the course of events in the tendon, in the transplanted muscle, in the sheath, and in the surrounding tissues subsequent to the operation. The material for this study was derived from eight operations on dogs and five secondary operations performed by Professor Biesalski on patients of his clinic. These secondary operations were performed 10, 16, 24, and 45 days after the original operations and in the fifth case after 3 years. It was possible without injury to the patient, not only to examine the tissues macroscopically but to remove small sections for microscopic study. In this way extremely valuable data were secured.

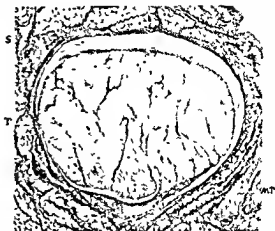


1 Cross section of the traumatized, transplanted tendon of the tibialis anticus 24 days after operation. The endotenon has proliferated to a marked degree; the surface of the tendon is irregular, the mesotenon is thickened and scarred. Here and there are minute hemorrhages in the tendon. *L*, lymphocytes and giant cells surrounding a localized hemorrhage.

1 THE FIXATION OF THE TENDON

It will be remembered that the physiological method of fixing the tendon consists in implanting it into the bone or cartilage, preferably at the site of the paralyzed tendon, so that it can be sutured to tendon as well as to the bone. The fixation has to meet the double demand of mechanical and of physiological security. By the latter I mean the union which occurs between the tendon and the surrounding tissues during the normal healing process. To insure this firm physiological fixation, the living tendon-cells, proximal to the fixation suture, should be in direct contact with the traumatized periosteum.

The experiments had to solve two questions. First, how long does the mechanical fixation of the suture last? Second, when does the physiological fixation begin? It is evident that if the mechanical fixation lasts until the tendon has actually healed fast to the new point of insertion, active exercise and electrical stimulation of the transplanted muscle can be begun immediately after the operation without danger of tearing away the tendon.

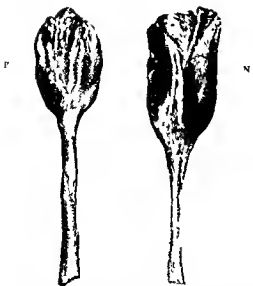


2 Cross section through the transplanted tendon of the peroneus longus in its course through the sheath of the tibialis anticus, 17 days after operation. Leitz obj. 1. Oc. 4. T. 160. In the cavity of the sheath are delicate connective tissue strands—the result of the slight trauma incidental to the operation. They are sufficiently elastic not to impede the free gliding of the tendon. Uniting the tendon to the floor of the sheath is a new formed mesotenon. The tendon itself is microscopically normal except for a slight proliferation of the endotenon and hypertrophy of the blood vessels. *S*, cavity of sheath; *T*, endotenon slightly hypertrophied, *M*, new formed mesotenon.

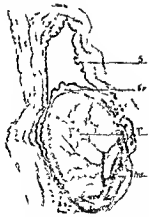


3 Cross section through the transplanted tendon of the flexor longus digitorum in its course through the sheath of the tibialis posticus 17 days after operation. Leitz obj. 1. Oc. 4. T. 140. Weigert's elastica stain.

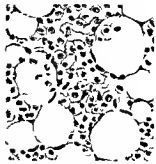
The tendon lies free within the cavity of the sheath and has the normal range of motion. Degenerative changes have however occurred: proliferation of the epitenon; the development of elastic fibers in the epitenon and of fat cells between the tendon bundles. *H*, Wall of sheath; *S*, cavity of sheath; *F*, elastic fibers in the epitenon; *Fp*, epitenon of tendon; *F*, *C*, islands of fat cells.



4 The gastrocnemius of a dog. To the left the muscle after 2 months post operative immobilization under maximum tension. To the right as contrast the normal gastrocnemius of the same dog. The overstretched immobilized muscle weighs one-half the normal and shows marked fatty degeneration. N normal gastrocnemius P pathological gastrocnemius.



5 Cross section through the transplanted tendon of the extensor proprius hallucis in its course through the sheath of the tibialis anticus three years after the operation. Leitz obj 1 Oc 1 T 150. The tendon sheath and mesotenon are normal. The epitenon is somewhat hypertrophied. Clinically and at the secondary operation the tendon showed the normal range of motion. S cavity of the sheath Ep epitenon T tendon M mesotenon.



6 Fat transplanted with the tendon of the peroneus longus 17 days after the operation. Leitz obj 5 Oc 1 T 160. Between the fat cells have appeared large pale staining mononuclear and multinuclear cells. Marchand and Maximon have observed similar cells after experimental transplantation of fat.

from its moorings. My observations show clearly that when the tendon is properly anchored this overlapping of the mechanical and physiological fixation actually occurs,



7 Cross section through the fascial plastic. Seventeen days after operation. Leitz obj 2 Oc 1 T 140. The fascia of the anterior muscular compartment has been inverted so that its deep surface covered with loose gliding tissue, lies superficial and serves as a bridge for the passage of the peroneal tendon from the lateral to the anterior muscular compartment. The gliding tissue is microscopically as well as macroscopically normal. I fatty gliding tissue. LS Lambert suture. V the musculocutaneous nerve. Sep septum intermuscular. ant. ant. inverted fascial flap of the anterior muscular compartment, V fascia of the peroneal compartment (doubled on itself).

and that therefore the early functioning of the tendon is a safe procedure.

a. *Dog experiment.* Tendon of the *extensor longus digitorum* drawn through the sheath of the *tibialis anticus* and fastened to its point of insertion. Examination after 4 days: fixation suture fast in tendon, traction on muscle produced flexion of foot without tearing away the tendon from its new insertion. As soon, however, as the suture was divided the tendon tore away, that is, the physiological union between tendon and bone had not yet occurred.

b. *Katie K.* Transplantation of *flexor longus hallucis* through sheath of the *peroneus brevis* for complete paralysis of the pronator muscles. After 1 week action exercises were begun. The tendon, however, did not function satisfactorily. Therefore 10 days after the original operation the operative site was exposed though the tendon was freely movable within the peroneal sheath it was adherent at the point where it passed through the septum in *termuscularis posterioris*. After the adhesions had been divided, electrical stimulation of the *flexor longus hallucis* produced abduction and eversion of the foot, thus showing the security of the tendon fixation. A silver electrode was placed against the muscle belly, sutured into position and its free end brought out through the bandage. Thereafter, daily electrical stimulation. Two weeks later, the patient could actively pronate the foot.

c. *Herbert B.* *Peroneus longus* for *tibialis anticus*. Secondary operation 16 days later. The tendon freely movable within the sheath of the *tibialis anticus*, but so firmly adherent to the internal cuneiform as to resist a traction of 8 pounds.

d. *Erna Z.* Transplantation of *flexor longus digitorum* to the scaphoid. At time of operation a silver electrode was sutured against the muscle-belly. Daily electrical stimulation was begun the day subsequent to the operation. Examination at secondary operation, 48 days later, showed the tendon to be firmly united to the scaphoid. When the muscle was faradized it could supinate the foot against considerable manual resistance.

e. *Hermann G.* *Extensor longus hallucis* for *tibialis anticus*. Secondary operation three years later. The insertion of the transplanted tendon could not be distinguished macroscopically from that of a normal tendon, even microscopically, were it not for the cellular reaction surrounding the silk sutures, it would have been impossible to recognize that the tendon had been transplanted.

The physiological method of tendon fixation thus enables the surgeon to begin post-operative exercises immediately after the operation, since it assures mechanical as well as physiological stability.

When other methods of fixation are used the early mobilization tends to tear the suture

out of the tendon. For example, a rabbit experiment performed with Dr. Henze: The divided *extensor longus digitorum* was sutured by the Lange stitch leaving a gap of one centimeter between its ends. On the third day electrical stimulation of the muscle was begun. At first the toes of the rabbit responded to the stimulation; but by the eighth day they no longer moved, though the muscle itself could be felt to contract. Autopsy on the twentieth day showed that the suture had torn out of the distal tendon stump.

The method of fixation I have adopted is by no means the only physiological means of implanting the tendon. Drawing it through a hole drilled in the bone (Mueller, Putti, Whitman) or fastening it to the bone by means of a nail (Codivilla, Jones) also meet the demands of the physiological method. However, the first is somewhat more complicated, the second necessitates introducing a non-absorbable foreign body and consequently carries with it the danger of subsequent infection.

2 CHANGES IN THE TENDON SUBSEQUENT TO THE TRANSPLANTATION

The tendon itself is peculiarly susceptible to traumatism. It must be handled with as much delicacy as a nerve. In one of the earlier operations where the truth of this fact was not appreciated and the tendon was grasped with forceps, the result was a marked hypertrophy of the endotenon. The entire structure of the tendon changed (Fig. 1), so that it looked more like scar-tissue than like tendon. In the later cases, the transplanted tendon showed a slight hypertrophy of the endotenon and of the blood vessels (Fig. 2) and was slightly softer than the normal; otherwise no changes were noted.

Immobilization of the tendon tends to its degeneration. This important fact, already demonstrated by the transplantation experiments of Lewis and Davis was emphasized by the results of a secondary operation 24 days subsequent to transplanting the *flexor longus digitorum* through the sheath of the *tibialis posticus*. For 24 days the tendon had been immobilized. Though it was still freely movable within the sheath of the *tibialis*

posticus, it was much softer than normal, and microscopically showed two significant changes (Fig 3): first, the appearance of fat-cells between the tendon bundles; second, the development of elastic fibers in the epitenon (the thin connective tissue coating of the tendon within the sheath).

It is probable that these regressive changes disappear when the tendon begins to function, for a specimen examined after 3 years of active function, was microscopically normal, despite a 5 weeks' preliminary immobilization.

3 CHANGES IN THE MUSCLE SUBSEQUENT TO OPERATION

The muscle also degenerates subsequent to the operation if it is not allowed to function. Particularly marked are the changes when the tendon has been sutured under abnormally high tension. In the article dealing with the physiology of tendons I emphasized the fact that normally a resting muscle during narcosis exercises no traction on the tendon; that is, the tendon is not under tension. Robert Jones, and before him, Hugh Owen Thomas, have in turn for many years taught us that an overstretched muscle degenerates to such a degree as to seem paralyzed. This significant physiological truth must be applied to the technique of tendon transplantation. The surgeon must be as careful not to overstretch the muscle by suturing the tendon under abnormal tension as he must be not to overstretch the extensor muscles of the wrist in a case of lead paralysis. Just as he conserves the normal muscular tone of the extensors by splinting the hand in a position of extension, so he conserves the transplanted muscles by suturing the tendon under normal tension.

Figure 4 shows graphically the effects of overstretching the muscle combined with immobilization. The muscles pictured are the gastrocnemii of a dog,—on the right, the normal unoperated on the left the operated. The Achilles tendon 2 months previously had been divided, reunited under the greatest tension possible, and the leg fixed in plaster bandage. At autopsy the overstretched muscle weighed one-half that of the normal, had shrunk to one-half the normal

size and showed microscopically and macroscopically, extensive fatty degeneration. This result was substantiated by five similar operations and by control experiments in which simple immobilization under normal tension caused only slight degeneration.

4 THE SHEATH SUBSEQUENT TO OPERATION

When the tendon has been drawn through the sheath of the paralyzed tendon, the complete return to the normal does not occur throughout its entire length. Owing to the unavoidable slight post-operative oozing, delicate connective-tissue strands form between the tendon and the sheath (see Fig 2). These strands are so delicate and elastic as to offer no serious hindrance to the gliding of the tendon. In some portions of the sheath even these delicate bands are absent and almost the normal histological picture is seen (Fig 5).

5 THE SURROUNDING TISSUES

The loose fatty tissue investing the tendon, (the paratenon) shows only slight changes when transplanted with the tendon. Here and there the fat-cells are replaced by peculiar cells twice the size of the white blood corpuscle, frequently containing two or more nuclei (Fig 6). These cells have also been observed by Maximow, Marchand, and by Rehn in fat transplantations. It is well, however, not to transplant much fatty tissue with the tendon, for in case a hemorrhage occurs into the fat, it is replaced by fibrous connective tissue and impedes the gliding of the tendon.

Where the tendon sheath has been opened to allow the transplanted tendon to enter, delicate adhesions also form, which close the opening, but do not seriously interfere with the motion of the tendon, provided it is allowed to function early.

If, however, the tendon is drawn through the interosseous ligament or through a fascial septum or if the periosteum is injured dense adhesions occur which render function of the tendon impossible. This important fact has been proved by numerous observations. In several rabbit experiments performed with Dr Henze where the periosteum had been

traumatized, the tendon was invariably found adherent. In a secondary operation on a patient of Professor Biesalski, where one year previous the flexor longus hallucis had been drawn through the interosseus membrane and sutured to the extensor longus hallucis — needless to say this operation was performed before the physiological method of transplanting had been introduced — the muscle was found tightly bound to the interosseus membrane. In the case already referred to (Katie K. — transplantation of the flexor longus hallucis through the sheath of the peroneus brevis), secondary operation 10 days later showed the tendon adherent exactly at that point where it was in contact with the traumatized fascial septum intermuscular posterior through which it has been drawn en route to the peroneal sheath. Within the sheath no adhesions were present.

It was because of these and similar observations that I devised the *fascial plastic* I described in the previous paper.

The plastic, it will be remembered, consists in inverting the fascia, so that its deep surface, covered with loose, gliding tissue (paratenion), should serve as a bridge for the passage of the peroneal tendon from its original fascial compartment to that of the tibialis anticus. Here also I was able to obtain positive proof of the effectiveness of the plastic at a secondary operation 16 days subsequent to the transfer of the peroneal tendon for the paralyzed tibialis anticus. Not only macroscopically, but microscopically (Fig. 7) the fascia and the paratenion were normal. No adhesions were present between tendon and the inverted fascia, the paratenion had conserved its normal glistening appearance, and the tendon glided as freely over the fascial bridge as within the sheath of the tibialis anticus.

The physiological method of tendon transplantation is thus given experimental sanction not only by animal experiments but by unusually convincing observations during secondary operations on human beings.

CLINICAL EXPERIENCES

Equally convincing of the rationality of the method are the clinical results. During

the last 4 years Professor Biesalski and I have performed some 50 tendon transplantations. In only one instance have I noted post-operative adhesions which interfered with the function of the tendon (the operation already referred to in which the flexor longus hallucis was transplanted for the peroneus brevis). Here the adhesions occurred exactly at the point where we had violated a physiological principle. In all other instances the transplanted tendon has behaved like a normal and has helped to restore the normal muscle balance. To achieve these results we have tried to be physiological not only in the operative technique but in the treatment before and after operation.

In the pre-operative treatment and in the selection of cases three principles are of paramount importance. First, never operate, no matter how long the interval since the incidence of the paralysis until the paralyzed muscles have been given adequate postural treatment. Frequently the paralysis is merely apparent, and the overstretched muscles recover their tone rapidly when their fibers are given a chance to contract. This lesson in muscle dynamics, which was preached 40 years ago by Thomas, frequently reiterated by Robert Jones, and substantiated experimentally within the last few years by Stoffel and by me, is to be adhered to in all instances except one, if the triceps suræ (gastrocnemius and soleus) is paralyzed, do not wait long before operating, since delay almost always means the development of a talipes cavocalcaneus.

Second, never attempt the impossible. The disrepute into which tendon transplantation has fallen, notably in the Parisian and Vienna schools, is due entirely to its abuse. The tendon transplantation should never be used to correct a bony deformity. On the contrary, bony deformities must be corrected preparatory to the tendon operation. The sole purpose of the transplantation is the restoration of the normal muscle balance. When too many muscles are paralyzed this is impossible. The dictum of a noted German orthopedist that three muscles suffice for the motions of the foot, cannot in my opinion bear the test of experience. It is far better

to arthrodize the foot, or perform Whitman's astragelectomy, or even to replace the paralyzed muscles with appropriate splints, than to attempt tendon plastics with insufficient material. I have never performed a tendon transplantation on the foot when more than three muscles were paralyzed, and only then with the full realization that the operation could merely improve the function of the foot, not restore it to the normal. Most suited to the operation are cases where one or two muscles are absent, or in spastic cases where a group of muscles — the peronei or the supinators, for instance — are overactive. There the transplantation, if properly executed, gives gratifying results.

Third, never operate when muscles are present capable of assuming the function of the paralyzed. This is particularly true of the quadriceps paralysis. Here, if a strong gluteus maximus and a strong triceps suræ (gastrocnemius and soleus) are present the action of the quadriceps can be dispensed with. Walking, standing with bent knees, climbing stairs, rising from a low chair are all made possible by the vicarious function of the gluteus and gastrocnemius. Under such conditions to risk an operation, no matter how tempting, would justly draw down the anger of the gods.

In the actual execution of the operation the physiological technique must be adhered to scrupulously. The operations are technically difficult. No one should attempt them without ample practice on the cadaver. A peculiarly accurate anatomical knowledge is necessary. The operator must know to a nicety the exact location of the tendon sheath, the level of the fascial planes, the line of insertion of the mesotenon, and a score of other details not given in the anatomical textbooks. Only then can he hope to operate with a minimal degree of trauma and with the maximum efficiency.

Three rules are again all important in the post-operative treatment

1 Never undertake the operation unless the after-treatment can be effectively and conscientiously carried out under your direction. To consider the operation as the final

link in the treatment would be as foolish as concluding a gastro-enterostomy before the mucosa suture had been completed.

2 Remember that no matter how skillful the surgeon, no matter how accurate the physiological technique, adhesions and degeneration of the tendon are apt to occur unless early function is instituted. Whenever the typical physiological fixation has been possible, it is safe and wise to begin active exercise of the transplanted tendon a few days after the operation. In young children to facilitate the early function I implant a silver electrode at the time of the operation, and can thus stimulate muscular contraction with far less pain than through the resistant skin. Of course, there are exceptions to the rule of early function. It is sometimes impossible to perform the ideal physiological fixation; for instance, in transplanting the flexor carpi ulnaris for the paralyzed extensor the tendons must be sutured to one another — a far less certain procedure than implanting the tendon into bone. Then 2 or 3 weeks must elapse before motion is allowed. Or again, in the transplantation of the flexor longus hallucis and the peroneus longus for the triceps suræ an immobilization of 3 or 4 weeks is usually necessary to allow the proper shrinkage of the posterior capsule of the ankle-joint. The immobilization is without danger since adhesions are almost excluded by the nature of the operation.

3 Remember that the transplanted tendon is not quite as strong as the normal and that usually it is called upon to do more than the normal amount of work. Therefore, it should be protected by suitable apparatus and strengthened by carefully graded exercises. This phase of the after treatment must be continued until the transplanted muscle can actually do the work required of it.

CONCLUSIONS

In these three papers I have tried to outline a system of tendon operations based upon the anatomy and physiology of the structures involved. In the first paper I explained first the inception of the work as the natural outgrowth of an experimental study of tendon plastics, in which the fundamental principle

of the physiological method — the restoration of the normal relationship between tendon and sheath as formulated by Biesalski in 1910 — was verified experimentally; second, I described the complicated finer anatomy of the tendon and the related connective-tissue structures — the sheath, mesotenon, paratenon, epitenon and endotenon; and third the hitherto unknown basic facts of tendon physiology — the mechanism of tendon motion, and the laws of tendon traction and tension.

In the second paper I formulated the operative technique of the physiological method and described three of the 20 operations which my experience has led me to consider physiological. This particular number of operations is not to be regarded as final. It is to be hoped that helpful competition and co-operation will soon enable us to include other operations in this category.

In the third paper I told how the physiological method has been substantiated by animal experiments, by the results of secondary operations and by four years of clinical experience.

I wish again to emphasize my deep indebtedness to my friend and former chief, Professor Biesalski. The entire structure of the physiological method rests upon his utilization of the sheath as the physiological preventive of adhesions. To him I am indebted, not only for unusual experimental and clinical opportunities, but for the constant encouragement of his stimulating personality.

To Dr Henze of New Haven also I feel particularly grateful, since he was the first to interest me in the many problems of tendon operation. During our work together in Munich in 1912 the germs of the physiological method were sown. To Dr Walter M. Brickner of New York I am indebted for many helpful suggestions, and to Mr Robert Jones of Liverpool for words of encouragement and for invaluable lessons in the laws of tendon surgery.

No one realizes more fully than I the shortcomings of these papers. For the physiological method, however, I offer no apology. It is a safe conservative procedure which in the hands of the competent surgeon is certain to

help many of our patients. I must again warn the unwary not to attempt the operations. They are technically difficult. They should not be performed unless the surgeon can conscientiously satisfy the following qualifications: First, he must be the absolute master of tendon anatomy — and I refer not to their gross topography as given in the standard textbooks but to their finer structures and relations, second, he must have performed the operations on the cadaver sufficiently often to know their every detail; third, he must have sufficient general surgical skill to operate with speed, accuracy, and minimal traumatism. Only when all these qualifications are satisfied is it fair to pronounce judgment upon the merits of the physiological method of tendon transplantation.

BIBLIOGRAPHY

- ADAMS. On the Reparative Process in Human Tendons after Subcutaneous Division for the Cure of Deformities. London 1860.
- ALLESANDRO. Tenotomien und chirurgische Sehnenverletzungen zwecks Verlängerung und Ueberpflanzung. *Ztschr f orthop Chir*, xxiii, 272.
- V AMMON. De Physiologia Tenotomiae. Dresden 1837.
- ANATONELLI and PIETRA. Della applicazione del trapianto tendineo. Milano 1906.
- ARAI, HARUJIKO. Die Blutgefäße der Sehnen. *Anatomische Hefte*, 1907, xxvii, 363.
- ASHDOWN. On the action of the hand muscles. *J Anat Physiol*, 1905, xxxiv, 7.
- BARDELEBEN (HAECKEL). Atlas der topographischen Anatomie des Menschen. Jena 1894.
- BIESALSKI. Ueber Sehnen Scheidenausschüttung. *Deutsche med Wchnschr*, 1910 No 35.
- BIESIADECKI, A., and UERZIG. Die verschiedenen Formen der quergestreiften Muskelfasern. *Wien Sitzungsberichte* 1859, xxxiii, 146.
- BILLROTH. Ueber die Epithelzellen und die Endigungen der Muskel- und Nervenfasern in der Zunge. *Deutsche Klin*, 1857, No 26.
- Idem. Beiträge zur path. Histologie p 35. Berlin 1852.
- Idem. Ueber die Epithelzellen der Linschlinge usw. *Arch f Anat Physiol wissenschaftl Med von F Mueller* 1838 163.
- DU BOIS REYMOND. Spezielle Muskelphysiologie oder Bewegungslehre. Berlin 1901.
- BORN. Ueber die Heilungsvorgänge nach Sehnenplastik. *Ziegler's Beitr* 1901, xxxiv, 41.
- BOLCHARD. Essai sur les guéris synoviales tendineuses du pied. Inaugural Dissertation. Strasbourg 1857.
- BESSE. Untersuchungen über die feineren Vorgänge bei Heilung von Sehnenwunden. *Deutsche Ztschr f Chir*, 1901, xxxiii.
- CAPLERO. Ueber den Wert der Plastik mittels quergestreiften Muskelgewebes. *Arch f klin Chir*, 1900, lxi, 26.
- CHEMIS. La synoviale tendineuse chez l'embryon et le fœtus humains. *Bibliothèque Anat* 1896, iv, 132.

- CHEMIN. Recherches sur les gaines synoviales tendineuses du pied Compt.-rend., de la soc. de biol., ser. 20, 10, 1896, Supplement. Séance du 29 février, p. 236.
- CHLUMSKY Ueber knocherne Sehnenverpflanzungen Arch f. Orthop., u. No. 2, 286.
- CODIVILLA Il trattamento chirurgico moderno della paralisi infantile spinale Polichinico, 1900, vii.
- Idem. La mia esperienza nei trapianti tendinei Polichinico, 1904.
- Idem. Meine Erfahrungen ueber Sehnenverpflanzungen Ztschr f. orthop. Chir., 1904, xii, 227.
- CONE Bull. Johns Hopkins Hosp., 1901, xii, No. 125.
- COOLIDGE. Some new points in tendon surgery Ann Surg., Phila., 1901, 285.
- CRUVEILHIER Les gaines tendineuses des péroniers latéraux. Bull. soc. anat. de Paris, 1862, xxxv, 438.
- DAMMANN Vergleichende Untersuchung ueber den Bau und die funktionelle Anspannung der Sehnen Arch. f. Entwicklungsmech. d. Organ xxvi, No. 3, 349.
- DAWBAHN Late suture of divided tendons Ann Surg., Phila., 1896, xxxii.
- DEBIAISE Contribution à l'étude des synoviales et des bourses séreuses, tendineuses, péri-articulaires et de l'anat. et de physiol., 1833, xxiv, 361.
- DEJANOWSKI Ueber den physiologischen Heilungsvorgang nach subcutanen Tenotomie der Achillessehne Inaugural Dissertation, Koebnigsberg, 1869.
- DOETZ Zur Frage ueber den fibrillaeren Bau der Sehnen spindeln oder der Golgischen koerperchen Arch. f. mikr. Anat., 1906, lxvii, 63.
- DREW Cases illustrating the late results of muscle transplantation for the relief of talipes valgus (paralytic) Proc. Roy. Soc. Med., Sect. Dis. Child., 1912, v, 121.
- DAOVNICK Ueber die Behandlung der Kinderlaehmung mit Funktionsheilung und Funktionsubertragung der Muskeln Deutsche Ztschr. f. Chir., 1896, xliii, 473.
- EDEN AND REIN Die autoplastische Fetttransplantation zur Neurolysis und Tendolysis Langenbeck's Arch., civ, No. 1.
- ELLENBERGER Handbuch der vergleichenden mikroskopischen Anatomie der Haustiere, 1906, I, 60.
- ENDERLEN Ueber Sehnenregeneration Arch. f. klin. Chir., 1893, xlv, 563.
- FELTZ De la régénération des tendons après leur section Thèse de doct. de Strasbourg, 1868.
- FICK Anatomie der Gelenke Jena 1904-1911.
- Idem Ueber die Anheftung der Muskelfasern an die Sehne Arch. f. Anat., Physiol., u. wissenschaftl. Med. von F. Mueller, 1856, 477.
- FISCHER, OTTO Theoretische Grundzüge fuer eine Mechanik der lebenden Koerper Leipzig 1906.
- FRÖISE AND FRANKEL Die Muskeln des menschlichen Armes Die Muskeln des menschlichen Beines Handbuch d. Anat. des Menschen, II, Part. 2, No. 2 a and 2 b Jena 1908 and 1913.
- GOCHT Beitrag zur Lehre von der Sehnenplastik Ztschr. f. orthop. Chir., vii, 34.
- GOLDTHWAIT Tendon transplantation in the treatment of deformities resulting from infantile paralysis Boston M. & S. J. 1895, p. 447.
- Idem Tendon transplantation in the treatment of paralytic deformities Boston M. & S. J., 1896, p. 29.
- Idem Direct transplantation of muscles in the treatment of paralytic deformities Boston M. & S. J., 1897, p. 480.
- GOLGI, C. Contribuzioni all' istologia dei muscoli volontari Ann. univers. di Medicina, 1880. In Rendic. d. r. Ist. Iambardo, xii, No. 1.
- Idem. Annotazioni intorno all' istologia normale e patologica dei muscoli volontari Arch. per le sc. med. 1882, v.
- GAUBER. Die bursae mucosae der spatia intermetacarpo-phalangea et intermetatarso-phalangea Mém. de St. Petersbourg par divers savants, 1850, viii.
- GUESTERBOCK Ueber die leinere Vorgaenge bei der Heilung per primam intentionem an der Sehne Virchow's Arch. f. path. Anat. (etc.), Berl., 1872, lvi, 352.
- HAGEN-TORNY Entwicklung und Bau der Synovial-membranen Arch. f. mikr. Anat., 1882, xvi, 597.
- HARTMANN Die Sehnscheiden und Synovialsacke des Fusses. Morphol. Arb., 1895, v, No. 2.
- HEINECKE Die Anatomie und Pathologie der Schleimbeutel und Sehnscheiden Erlangen, 1868.
- HEYLE Handbuch der anatomischen Anatomie des Menschen Braunschweig 1871, vol. 1.
- HENZE AND MAYER. An experimental study of silk-tendon plastics with particular reference to the prevention of post operative adhesions Surg., Gynec. & Obst., 1914, xix, 10.
- HOFFA Die experimentelle Begründung der Sehnenplastik Verhandl. d. Gesellsch. f. deutsch. Naturf. u. Aerzte, LXXXIII Versammlung zu Hamburg, 1901, 134.
- Idem Am. J. Orthop. Surg., u. No. 1.
- HOVER Mikroskopische Untersuchungen ueber die Zunge des Frosches Arch. f. Anat., Physiol., u. wissenschaftl. Med., von F. Mueller, 1859, xxvii, 404.
- HOXLEY Cannstatt Jahresbericht, 1854.
- JUVARA Arch. de méd., Par., 1898, vi, 261.
- JONES On Certain Principles and Methods in the Surgical Treatment of the Paralysis of Children Liver pool 1909.
- Idem An address on arthrodexis and tendon transplantation Brit. M. J., 1908 March 28.
- KIRMISSON Rev. d'orthop., 1907, No. 6.
- KLAFF Chirurgische Operationslehre von Bier, Braun, und Kuemmel, vol. iii, p. 892.
- KOELLIKER Mikr. Anat., Leipzig, 1850, ii, 235.
- Idem Handbuch der Gewebelehre des Menschen 1889 sixth ed. p. 375.
- KRATSE Ersatz des gelahmten Quadriceps femoris durch die Flexoren des Unterschenkels Deutsche med. Wchnschr. 1902, Nos. 7 and 8.
- KRONE Ueber die Muskelinsertionen an der Handwurzel und die Beziehungen zwischen den Sehnen und dem Handapparat des Handgelenks Inaugural Dscurtaion, Goettingen 1906.
- LANGB, F. Die Sehnenverpflanzung Ergebnisse f. Chir. u. Orthop., 1911, ii.
- Idem Ztschr. f. orthop. Chir., 1904, xii, 16.
- Idem Weitere Erfahrungen ueber seidene Sehnen Muenchen med. Wchnschr., 1902, No. 1.
- LEVY Ueber den Einfluss von Zug auf die Bildung faserigen Bindegewebes Arch. f. Entwicklungsmech. d. Organ 1904, xviii, 184.
- LEWIS AND DAVIS Experimental Direct Transplantations of Tendon and Fascia.
- LOGNOWN Zusammenhang von Muskelfasern und Sehnenfasern Arch. f. Anat. u. Entwicklungsgesch. 1912, 172.
- LOVELL AND TANNER Synovial membranes with special reference to those related to the foot and ankle J. Anat. & Physiol., 1903, series iii, xlii, 415.
- LUNGETTI Arch. Anat. et Embriol., vi, 585.
- Idem Contributo alla conoscenza dello sviluppo delle synoviali tendinee Atti del Cong. Nation. Italiani, Milano, 1906, 559.

- MARCHAND Process der Wundheilung mit Einschluss der Transplantation Stuttgart 1907.
- MENCIERE. Recherches expérimentales sur la création de tendons artificiels Province méd., Lyon, 1906, No 47.
- MILLIKEN Supplementary notes on tendon grafting and muscle transplantation for deformities following infantile paralysis N Y Med Rec., 1896, No 28
- MOSEWITZ Ersatz des Gluteus durch Sehnenplastik Wien klin Wchnscr., 1907, No 16
- MUELLER Sehnentransplantation und Verhalten der Sehnen beim Plattfusse Zentralbl f Chir., 1903, p 40
- NICOLADONI Nachtrag zur Pes calcaneus und zur Transplantation der Peronealsehnen Arch f klin Chir., 1882, xxvii, 660
- NATZLER Experimentelles zur Sehnenüberpflanzung nahe Ztschr f orthop Chir., xxviii, 455
- PAGET, F Lectures, 1853, I, 265
- PIROGOFF Ueber die Durchschneidung der Achillessehne als operativ-chirurgisches Heilmittel Dorpat, 1840
- PONWASOZKI W Ueber die Beziehung der quergestreiften Muskeln zum Papillarkörper der Lippenhaut Arch f mikr Anat 1887, xxx
- POIRIER AND CHARPY Traité d'anatomie humaine, 1901
- PONCET Allongement en accordon (de l'allongement d'un tendon divisé, etc.) Gaz hebdomadaire de médecine et de chirurgie, 1891, 373
- PUTTI Per diminuire od abolire il periodo di immobilizzazione postoperatoria nei trapianti e nelle fissazioni tendinee Rev osp 1912, No 6
- RANVIER Traité technique d'histologie, 1875, 503
- Idem Des éléments musculé et des éléments élastiques de la membrane rétrolinguale de la grenouille Compt rend d Acad d sc., 1890, cx, 504
- RALPER KOPCICH Sehnnenscheiden, vaginae tendinum, Lehrbuch der Anatomie, 1906, part, 3, p 516
- REICHERT Mueller's Arch., 1846
- REITTER Sur le développement morphologique et histologique des bourses muqueuses et des cavités peritendineuses J d anat., 1896, xxii, 256
- Idem Sur le développement des cavités closes tendineuses et des bourses muqueuses. Compt rend et mém soc de biol., 1895 u 70
- REIN Klinischer Beitrag zur freien Sehnenverpflanzung Arch f klin Chir., 1913, cii, 15
- RICHARDSON Tendon suture Boston M & S J 1911, p 752
- RITTER Eine neue Methode der Sehnnennaht Med Klin., 1908, 1191
- ROSTHORN Die Synovialsacké und Sehnnenscheiden in der Hohlhand Arch f klin Chir., 1887, xxv, 513
- SAPPEY Recherches sur les vaisseaux et les nerfs des parties fibreuses et fibrocartilagineuses Compt rend Acad d sc., 1866, lxi, 1116
- Idem Traité d'anatomie descriptive vol II
- SCHLEPPERDECKER AND KOSSEL Gewebelehre 1891 II
- SCHULTZE Ueber den direkten Zusammenhang von Muskelfibrillen und Sehnenfibrillen Verhandl d physiol med Gesellsch zu Würzburg 1911, xl
- Idem. Arch f mikr Anat., 1912, lxxix
- Idem Die Kontinuität der Muskelfibrillen und der Sehnenfibrillen Sitzungsberichte der physiol-med Gesellsch zu Würzburg, 1911
- Idem Verhandl d anat Gesellsch in Leipzig, 1911, p 65
- SEEMANN Anatomische Untersuchung ueber die Sehnnenscheiden der Fussbeuge in Beziehung zur sogenannten Tendovaginitis und perimyositis crepitans Beitr z klin Chir., 1908, lx, 355
- SEGGER Histologische Untersuchung ueber die Heilung von Sehnenwunden und Sehnnendefekten Beitr. z klin Chir., 1903, xxxvi, 342
- SEVER An experimental study of tendon regeneration Boston M & S J., 1911, 748
- SILVER An experimental study of the influence of necrosis produced by sutures in tendon suture and transplantation Am J Orthop Surg, iv, No 3
- SPALTERHOLZ Handatlas der Anatomie des Menschen Leipzig, 1904
- STOFFEL, Verhandl d deutsch orthop Gesellsch., 1913 and 1914
- STRASSER Lehrbuch der Muskel und Gelenk-mechanik Berlin 1908, I
- TUBBY Results in tendon grafting in infantile and spastic paralysis Brit M J., 1901, 585
- VIERING Experimentelle Untersuchung ueber die Regeneration des Sehnnengewebes Virchow's Arch., cxiv, 352
- VULPIUS AND STOFFEL Die Behandlung der spinalen Kinderlähmung
- Idem Der heutige Stand der Sehnenplastik Ztschr f orthop Chir., 1904, xii, 1
- WAGNER, P Ueber die Muskelfaser der Evertibraten Arch f Anat., Physiol u wissenschaftl Med., 1863, 211
- WEISMAN, A Zur Histologie der Muskeln Ztschr f rationelle Med., 1865, xxiii
- Idem Ueber die Verbindung von Muskelfasern mit ihren Ansatzpunkten, 1861, xii
- WEISS Beiträge zur Kenntnis der Tendovaginitis crepitans Beitr z klin Chir., 1907, liv, 513
- WHITMAN Operations for the relief of paralytic deformities with especial reference to tendon transplantation introduction, history, indications for operation N Y M J., 1902, May 3
- Idem Textbook of Orthopedic Surgery
- WHITTAKER The arrangement of the synovial membrane in the palmar digital sheaths J Anat and Physiol., 1907, xli, 155
- WILSON Internat M Mag., 1893, August
- WOLLENBERG Die Arterienversorgung von Muskeln und Sehnen Ztschr f orthop Chir., 1905, xiv, 312
- WOLFF, W Ueber den Zusammenhang der Muskeln mit der Sehne Inaugural Dissertation, Berlin, 1877
- Idem Ueber ostale Sehnenplastik Deutsche med Wchnscr., 1902, No 18
- YAMAGATA Zellenstudien an sich regenerierenden Sehnnengewebe Virchow's Arch., 1894, cxxix, 308

DEPARTMENT OF TECHNIQUE

RECTAL DRAINAGE OF APPENDICEAL PELVIC ABSCESS

By V. L. SCHRAGER, M.D., Chicago

THE literature of appendicitis has been exhausted from all its angles. However, the definite indication of this type of drainage in selected cases, as well as the scarcity of the literature on this particular subject, justifies its consideration.

An acute appendiceal process may be associated with, or followed by, an abscess, the location of which may vary in its anatomical position. The usual appendiceal abscess is situated in the vicinity of the appendix, either on the parietal peritoneum or between loops of bowel, the level and location of which depend upon the position of the appendix, which has a wide range of excursion. In a less common group of cases, the abscess may spread backward and upward, the lumbo or posteroparietal type, or upward and forward, the anteroparietal type, or downward, the rectal or the pelvic type.

A Frankel, Penzoldt, Riedel, Curshman, have called attention to the necessity of rectal examination in acute appendiceal processes early in the history of appendicitis. The etiology of the pelvic type of appendiceal abscess is ordinarily the appendiceal pus which gravitates into the pelvis, particularly when the appendix hangs over the brim of the pelvis, in other words, it is a gravity abscess. This process is naturally favored by lack of omental or intestinal adhesions, which ordinarily tend to limit the abscess in the appendiceal zone. In the opinion of Archibald MacLaren of St. Paul, practically all pelvic abscesses in the male are appendiceal in origin. The cases in which there are two appendiceal abscesses, either distinctly separate or communicating with one another, demand another explanation. A. C. Bernays collected the serous fluid from the pelvic floor of a number of cases of acute appendicitis with beginning peritoneal reaction, but without pus at the time of operation, and found that it contained a rich bacterial flora, which incubated on suitable media developed very prolifically. Sonnenberg also called attention to the reaction serous peritonitis which accompanies an acute intra-

abdominal focus. This fluid gravitates and may subsequently become infected. If this theory were true, it would be logical to assume that the Fowler position, so extensively employed in this country in acute appendicitis, may favor, in a number of cases, the late development of pelvic abscesses secondary to an acute appendicitis.

Brard and Patel divide the pelvic abscesses into two classes: (a) peri-appendiceal, in which there is direct connection with the abscess surrounding the appendix, and (b) para-appendiceal, in which the abscess is above the pelvic brim and has no direct connection with the abscess below. Broca (1) also distinguishes two types of appendiceal abscesses: the superior and inferior pelvic. The first originates near the superior straight, which does not lend itself in its early stage to either abdominal or rectal palpation. These abscesses may become later on either distinctly iliac or pelvic, or both iliac and pelvic. The second, inferior pelvic, is palpable through the rectum, as it is situated on the rectal wall.

The following statistics give us an idea of the frequency of the pelvic type of abscess. Archibald (2) found among twenty-two cases of appendiceal abscesses that seven were in the pelvis. Rotter (3) found forty pelvic abscesses in one hundred and thirty-two appendiceal abscesses. Of these seven were in the true pelvis and could not be palpated through the abdomen. O. Sprengel collected one hundred and twenty-six cases, of which eleven were pelvic. Hochegg puts the percentage of pelvic abscess in appendicitis at thirty, which is entirely too high. Hagen's statistics give twelve per cent. In Sonnenberg's collection of one hundred and fifty-six cases there were eighteen abscesses in the small pelvis and six in the pouch of Douglas.

The pelvic and perirectal abscesses are either self limited by agglutinated loops of bowel and fibrinous adhesions, or communicate with the original abscess. It may be well to mention that in a few cases the sigmoid flexure was interposed between the abscess and the rectal wall, which, of course, constitutes a source of danger in the

event of drainage. A perirectal or pelvic appendiceal abscess may originate either in the course of an acute appendicitis or in many cases develop some time after the onset of the acute process. It is this particular occurrence that demands recognition by the clinician. In our series of four cases the first one developed a perirectal abscess on the twenty-first day, the second one toward the end of the tenth day, the third one on the tenth day and the last one twelve days after an operation. A perirectal abscess may develop either as a late complication in cases which have not been drained at all, or those which were insufficiently drained, or it may develop in spite of efficient drainage. The histories of our four cases are given below, in brief, and illustrate the clinical and operative course of appendiceal processes complicated by perirectal abscesses.

CASE 1. D. C. age 12, Chicago. After an indisposition in the patient was seized with very violent abdominal pains associated with nausea and vomiting, and some rise in temperature. A few hours later when examined she had a definite tenderness in McBurney's zone, a temperature of 101° and a leucocytosis of 24,000. There was considerable pus in the urine. A diagnosis of acute appendicitis was made and confirmed by another clinician. Exploration within twenty-four hours from the time of the onset revealed a mild catarrhal appendicitis. The caecum, however, was intensely red and oedematous and exhibited a very definite line of demarcation from the colon very similar to the line of demarcation one finds in gangrene.

The pathology was somewhat unusual and not being sufficiently familiar with such a condition we closed the abdomen without drainage after removal of the appendix. Following the operation the patient developed very marked vesical symptoms and a septic type of temperature. The general condition of the patient was fair and having no palpable explanation for this temperature we sent the patient home after sixteen days. The symptoms persisted and for a period of two weeks she ran a strikingly septic temperature. The urine was loaded with pus cells and the patient developed a very marked suprapubic tenderness. In the course of a week there was a very definitely rounded mass in the median line from the pubis to the umbilicus. Dr. A. J. Ochsner who was called in consultation immediately recognized the condition and suggested rectal drainage which was performed according to his technique. There was a sudden drop in temperature which had persisted for several weeks and the patient made an absolute convalescence within a couple of days. There were never any untoward symptoms after this.

CASE 2. Mrs. M. P. age 37 Chicago. Was admitted to the Presbyterian Hospital July 27, 1914 and assigned to my service. She had definite symptoms of appendicitis with marked peritoneal reaction. The usual appendectomy was performed draining the appendiceal region with two cigarette drains. The appendix was deeply imbedded in adhesions and had a perforation at the tip. The patient did not convalesce well, ran a septic type of temperature and had marked bladder symptoms. On the basis of the previous experience with the preceding case I made a rectal examination and found a very definite, fluctuating mass on the upper wall of the rectum. The patient was placed in the lithotomy position the rectum

dilated and the abscess cavity located by inserting an aspirating needle into it. The abscess was drained, the patient making an immediate and absolute recovery.

CASE 3. Master I. U. age 3 developed sudden severe abdominal pains associated with a sudden rise of temperature. For several days the abdominal pains and temperature persisted and as there was very little localized tenderness or abdominal rigidity, no definite diagnosis was made. On the fourth day of the disease a severe cystitis occurred which masked all symptoms. A rectal examination made on the tenth day at which time the temperature was in the neighborhood of 102° and the leucocyte count 34,000, a huge perirectal abscess was found on digital examination. The abscess was drained through the rectum and the patient made an absolute and uneventful recovery within two days.

CASE 4. A. M. age 16 Chicago, was brought into the hospital with a very well-defined appendicitis. An operation revealed a very acute appendix with a small abscess cavity which was drained. The patient did very well for eight days. On the ninth day he refused his tray, complained of pain in the lower abdomen, felt nauseated, and had a rise in temperature to 101° . This persisted for a couple of days during which careful physical examination of the abdomen and chest revealed no findings that could explain this sudden occurrence at this late date. On the twelfth day, we discovered a good sized perirectal abscess which was promptly drained under gas anaesthesia. After this the temperature dropped to normal and all symptoms disappeared.

Rectal drainage of appendiceal abscess has its partisans and its opponents. Those who favor the method have obtained striking results and recommend it in males, young females, and children. Oscar H. Allis, Archibald MacLaren, and A. J. Ochsner in this country, Rotter, Morrison, Lange, Jaboulay, Graser, in Europe, favor this method of treatment in selected cases. Archibald MacLaren (4) states "Many cases of pelvic appendiceal abscesses in men and boys have been opened and drained in both sides, both loins as well as having suprapubic stabs for large glass or metal tubes, and in spite of all these different drains have died of chronic sepsis or amyloid liver because the dependent portions of peritoneum have not been drained. Some of these abscesses if left alone will perforate into the rectum and be cured. In married women all Douglas pouch or perirectal abscesses should be drained through the cul-de-sac into the vagina. Pelvic abscesses have been opened at times by routes other than the rectal or vaginal. Jaboulay (5) employed the parasacral route, Maclair (6) and Rotter the perineal route, the latter resorting to it eleven times.

In fairness to the subject I wish to quote John B. Deaver who in his monograph "Appendicitis: Its Diagnosis and Treatment," third edition, page 393, states "The evacuation of this pelvic variety of peri-appendicular suppuration through the vagina or rectum I regard as opposed to the

dictates of sound surgical practice and as attended by more risks to the patient than the operation through the abdominal wall. By the abdominal route nothing is taken for granted, the field of operation is under the eye, and the appendix can be removed." Deaver further states: "Of all varieties of appendicitis attended by suppuration, these cases of pelvic suppuration due to appendicitis have been, in my hands, among those most successfully treated by operation. The reason for this success is that the general peritoneal cavity can be so thoroughly protected by gauze packs and that in consequence the appendix can be safely removed at the primary operation."

The diagnosis of a pelvic appendiceal abscess can be easily made by rectal palpation. The obligation of a keen clinician, however, is to suspect and foresee this possibility. Any doubtful, acute process of the lower half of the abdomen, particularly in the male, should arouse sufficient suspicion to justify a rectal examination. Cases of acute appendicitis pending for several days or weeks, whether operated upon or not, strained or not, cases which do not go on to convalescence as the average do, should direct our attention to the possibility of a purulent collection situated beyond the region of the appendix. According to Sonnenberg these cases betray their existence by a more or less severe proctitis which sometimes masks the real nature of the trouble. Some cases have more or less severe bladder symptoms.

Rectal drainage as a surgical procedure has the theoretical disadvantage of being an uncertain surgical method, being conducted in the dark, without a distinct knowledge of the tissues involved. Those, however, who have employed the method in cases with a very definite indication for its practice have necessarily become enthusiasts. Oscar H. Ellis in a discussion before the Section of Surgery of the College of Physicians of Philadelphia, November 8, 1895, at which John R. Roberts and John C. DaCosta took part said "he did not defend the operation as one of high grade scientific surgery, but all his cases got perfectly well and this is better than to have a scientific operation where the patient dies." Our four cases have turned from desperately sick patients into happy convalescents, in every instance, and while we had theoretical scruples and hesitancy in performing this operation, we feel, from a practical standpoint, very much as Ellis does. By the way of illustration of the rapidity with which some of these patients recover from an operation of this kind, I wish to quote a case of R. Peterson (7). He opened a large appendiceal abscess which pointed into the

rectum and contained a gallon of foul pus. On the sixth day after the rectal drainage the patient walked home, one and a half miles.

The technique employed in our cases was suggested by Dr. A. J. Ochsner. We followed Dr. Ochsner's technique in our first case, which is as follows. The patient is shaved and prepared as for a hemorrhoid operation. Either gas or ether may be used, although in adults gas is preferable. The patient is placed in the lithotomy position with the buttocks well brought down over the edge of the table. The sphincter is next dilated until it is completely paralyzed. Of course, ether is more suitable for this step than gas. Two long bladed, right angle, flat retractors are next introduced into the rectum, depressing the upper and lower rectal walls. If the diagnosis is correct, the fluctuating mass soon appears in view, being covered by a smooth, shining rectal mucosa. A small incision is made with scissors or knife in the anterior rectal wall and a sharp pointed forceps, dressing forceps, or the blade of scissors is introduced through this buttonhole. The pus generally rushes out with great rapidity, showing that it was held under tension. The evacuation may be assisted by pressing upon the lower abdominal wall. A rubber tube is then inserted high up into the rectum while another one is introduced into the abscess cavity, thus preventing the feces from entering into it. The tubes are left in place for two or three days and, in our experience, they were always spontaneously expelled. There is practically no after treatment, except that the bowels are intentionally constipated as after an ordinary hemorrhoid operation. In the last two cases we have inserted an aspirating needle dipped into lysol prior to the opening of the abscess. Some irrigate the abscess cavity and on account of adhesions, have no fear of forcing the fluid into the abdominal cavity. There are a number of variations in technique. Some sponge the rectum with alcohol before opening the abscess. The bladder is either previously catheterized or as Morrison of England does the catheter is left in place as a guide. Lange dilates the sphincter and removes the feces dry, so as not to run the risk of having the fluids come down in the course of operation. Jaboulay occasionally unites the lateral wall to the rectum temporarily so that the upper half drains the abscess while the lower one drains feces. Some surgeons use Priors exaggerated lithotomy position such as is used for the cystoscopy of the female bladder. One surgeon uses the weighted speculum as used in vaginal work. For drainage some use a simple rubber tube, a

winged tube, or a T-tube. There are certain dangers connected with the performance of this operation. The chief danger, in our mind, is an operation done without any definite indication, in which event needles, scissors, or other instruments are pushed blindly through a septic mucous membrane. An adherent loop of bowel may be injured. The abscess cavity may become infected with stool. In the majority of cases, however, the rectal opening acts as a valve, allowing pus to escape but no stool to get in. A few cases developed a phlegmon of the pelvic floor. Occasionally a secondary hæmorrhage occurs.

CONCLUSIONS

- 1 Rectal examination is a valuable aid in the diagnosis of acute inflammatory processes of the lower abdomen.
- 2 A number of cases of acute appendicitis are

either associated with or followed later on by pelvic abscesses, some of them pointing into the rectum.

3 Rectal drainage of appendiceal abscesses is a simple procedure and can be resorted to, in emergencies, even by less experienced surgeons.

4 Cases of suppurative appendicitis convalescing badly occasionally do so because the dependent abscess is not drained.

5 In desperate, as well as suitable cases, rectal drainage is a very gratifying procedure.

BIBLIOGRAPHY

- 1 BROCA Bull de med., Par., 1901, June 29, 589.
- 2 ARCHIBALD Montreal M. J., 1890, p. 81.
- 3 ROTTER Deutsche med. Wchnschr., 1890, No. 30.
- 4 MACLAREN A. Ann. Surg., Phila., 1908, xlii, 1034, also St. Paul M. J., 1908, January.
- 5 JABOLLAI Rev. de chir., 1892.
- 6 MACLAIRE Bull. Soc. anat. de Par., 1897, p. 868.
- 7 PETERSON Am. Gynec. & Obst. J. N.Y., 1900, xvi, 240.

SPLANCHNOPTOSIS: A NEW OPERATION FOR GASTROPEXY AND CYSTOPEXY¹

By J. ALVARADO WALL, M.D., SANTIAGO, CHILE

I WISH to give a very short account of a case of abdominal ptosis in which I had the opportunity to perform a gastropexy using a method not yet described which I shall call cystopexy and about which I have found no

mention in the literature. The procedure consists, as shown in Fig. 3, in passing three or four sutures from deep in the anterior wall of the stomach up through and fixing them to the peritoneum and fascia in the upper part of the



Fig. 1 Condition before operation

Fig. 2 Condition after operation

¹ Read before the Medical Society of Santiago, Chile

median incision. In other words it is a method similar to that used by Duret and Rovsing except that it has the advantage of allowing folding in two directions, longitudinally and transversely.

At one of the recent meetings of the Santiago Medical Society, Dr. Benavente, Senior Surgeon to the Hospital San Salvador, called attention to a new fact regarding cholecystostomy. He believes that the separation of the gall bladder from its hepatic bed is a step of paramount importance in that it allows retraction of this viscus, thus preventing, or at least minimizing, biliary stasis. I am of the opinion that *cystolysis* as I shall call this procedure, has, in certain cases of ptosis and chronic cholecystitis, a very precise indication. I do not agree with Dr. Benavente as to the mechanism of retraction, for while he believes that the muscular coat is capable of becoming the starting point of active shrinking, I am inclined to attribute the shrinkage to the secondary cicatricial process.

As has already been stated there is not always an indication for this procedure. In my own case it would have been impossible. As careful examination revealed but a full and increased mobility of the gall bladder without hepatoptosis, I felt justified in passing a purse string suture through the superficial layers of the fundus, tying both ends near the anterior border of the liver (Fig. 1).

I do not claim that cases are common in which single cystopexy is sufficient. As a general rule it is necessary to do first a cystolysis and finish with fixation. In this way we correct at the same time the vicious position and the hamosta-

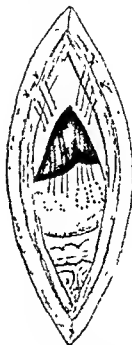


FIG. 1. See text for description.

sis. I refer only to cases of vesicular ptosis not associated with hepatoptosis.

I am indebted to my friend Dr. Silva Leon, for his willingness and kindness in drawing the accompanying illustrations.

AN UNUSUAL CASE OF FRACTURE OF THE OLECRANON PROCESS

By C. WINMILL PERKINS, M.D., NEW YORK.

MODERN surgeons are more inclined to resort to newer methods of treating fractures, such as grafting, plating, and the different mechanical contrivances for adjusting and setting fractures, than to attempt to adapt the older methods to the more recent means of dealing with these cases. In many instances I believe that with a little aid nature will perform wonders. The following radiograms and history will briefly illustrate what I consider a very interesting and unusual case.

Patient a man of 38 years fell from a scaffolding and sustained a Colles' fracture of the right arm and a comminuted fracture of the olecranon process of the left arm. Radiograms were immediately taken of both fractures. The Colles' fracture was treated according to the approved methods.

As the fracture of the olecranon was of the variety in which all the fragments were broken into small pieces, the question immediately arose as to what would be the best procedure for treatment. Most authorities recommend incision and replacing the portions of broken bone either by wiring or suture according to the exigencies of the case. Some of the fragments were so small that it seemed best to advise their removal and adjust the remaining large fragment of the olecranon in place as near as possible to its original position. However conservatism prevailed and it was decided not to do an open operation but to wait and see what nature would do and if an operation were necessary it could be done later.

The patient was therefore anesthetized, the arm put in extension and an effort made to align the fragments and place the remaining portion of the olecranon in as near as possible its original position over the trochlear surface of the lower end of the humerus.

Adhesive strips and a gauze pad together with a wire splint were finally placed on the elbow. In ten days time the splint was removed and the arm put in the first degree of flexion. Passive motion was instituted at the same time. In seven weeks time the patient made an almost perfect recovery as regards function of the joint.

Radiogram (Fig 1) illustrates the fracture immediately after the injury. Fig 2, ten days afterward, shows alignment of the fragments and partial regeneration of the olecranon process. Figure 3 illustrates the entire new olecranon process formed. At the time the last radiogram was taken, there was good motion to the joint with slight limitation of extreme extension.

I am indebted to Dr. F. H. Goddard of Rochester, New York, for the radiograms that accompany this sketch.

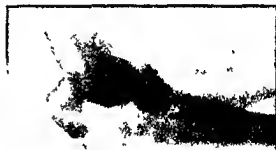
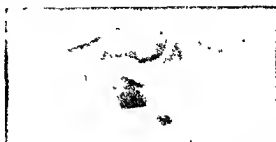


Fig 1 Radiogram immediately after operation
 Fig 2 Radiogram of fracture ten days after fracture
 Note alignment of the fragments
 Fig 3 Radiogram showing entire new olecranon process

ROENTGENOLOGIC DIAGNOSIS OF PROSTATIC TUBERCULOSIS AND PROSTATIC STONES

By MAX KIRCHMANN, M.D., Chicago

CONTRARY to Socin¹ who in his monograph "Diseases of the Prostate" claimed that tuberculosis of the prostate is an extremely rare occurrence, all authors of today are agreed that the affliction is quite common.

In most cases of genito-urinary tuberculosis the prostate is also infected and Hutter even states that genito-urinary tuberculosis originates in the gland. Of course, this is going too far, but there are in the literature numerous cases to be found where the initial tuberculous focus was located in the prostate. Most cases undoubtedly are infected from a diseased epididymis, quite a few from tuberculous kidneys or seminal vesicles. Baumgarten maintains that a descending infection with Koch's bacilli affects the urinary organs only, while an ascending infection confines itself to the sexual organs.

The pathology can be shortly described by the appearance of disseminated nodules which have the tendency to conglomerate, they are transformed into caseous masses, indurated connective tissue, and finally into calcification.

From the roentgenological standpoint this final development is of great interest, because in this stadium we are able to make the diagnosis from the characteristic appearance of the plate alone, as the following case will show.

(112 10th and 11th St.)

I am deeply indebted to Dr. W. T. Beltz for the following history:

K., age 27, married twenty years, wife never pregnant, acquired loss 25 years ago, and had spent a treatment for the same for several years. General health good, aside from vesical irritation for which he consulted Dr. Beltz January 11, 1915.

This irritation marked by frequent urination, diurnal and nocturnal alike was first noticed over twenty years ago some months after apparent recovery from gonorrhea. For some ten years his frequent micturition was intermittent, being sometimes unnoticed for several months. During the past eight years, however, it has been continuous and has been steadily aggravated.

Present state. Well nourished, active man, no complaints except micturition every hour or less day and night.

Urine voided contains many pus-cells, also blood, streptococci and streptococci. No tubercle bacilli detected. Left epididymis vesicle and both sides of prostate nodulous, some tenderness but no swelling over left kidney. Urethral stricture opening No. 24 at wound at bifurcated junction. Sixty ccm. of residual urine in the bladder. Wassermann negative. Temperature 99.8° (2 o'clock p.m.).

Injection of 1 cc. milligram of tuberculin was followed by pronounced general local and local reactions. Treatment has consisted aside from gradual dilatation of stricture of gradually increasing doses of low "ary emulsion of tuberculin" and tonics.

Within four months the nocturnal urinations decreased from 7 to 8 to 2 to 2 each night. The diurnal intervals lengthened from 30 to 40 minutes to 2 1/2 to 3 1/2 hours. Two tuberculous ulcers in the trichium healed.

The fact that there still remained some urinary fre-



Fig. 1. See text for description.



Fig. 2. See text for description.

quency and pus—contrary to Dr Belfield's usual observation of such cases treated with tuberculin—led the doctor to suspect calculous deposits beyond the range of the cystoscope. To determine this question he was referred to me July 24, 1915 for roentgen examination.

The plate (Fig. 1) showed the same condition as did a few plates I have made of cases of tuberculous kidneys and therefore without knowing anything about the history and the clinical findings of the case, I reported to Dr Belfield that we had to deal with a case of tuberculosis of the prostate, a diagnosis which the doctor confirmed.

As far as my knowledge of the literature, American and foreign, goes, this is the only case in which a positive diagnosis of secondary prostatic tuberculosis was made from the roentgen examination alone. As far as differential diagnosis is concerned there is only one condition of the

prostate which roentgenologically comes into consideration, i. e., calculi of the prostate.

One glance at Fig. 2 will enable the experienced observer to differentiate between the two conditions. The shadows of the always multiplex stones lay close together, in fact, if the technique is faulty one may diagnose only one stone present.

Roentgenographic diagnosis of stones in the prostate has been reported a few times. Goldin-Bird¹ was the first to publish such a roentgenogram, and Frisch in his handbook maintains that stones in the prostatic gland which are deeply imbedded in the parenchyma of the gland, can never be detected except by roentgenography.

¹Bull. N. J., 1908.

COMBINATION NEEDLE HOLDER AND LIGATURE SCISSORS¹

BY LEAF R. STEWART, M.D., CLEARFIELD, PENNSYLVANIA

Surgeon to the Clearfield Hospital

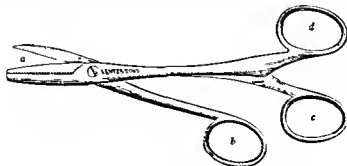
THE accompanying cut shows a combination ligature scissors and needle holder which I have used in my clinic during the last nine months with complete satisfaction.

Prior to the manufacture of this instrument under my direction by an instrument house in Philadelphia, it had been my custom when placing sutures to hold a pair of scissors in thumb and little finger and a Deaver needle holder in the thumb and ring finger of the same hand on top of the scissors. This way of working afforded considerable speed but was cumbersome.

The instrument I am about to describe has all of the advantages of the Deaver needle holder, after which the needle holder portion is modeled, and in addition it enables one by bringing the

middle finger into play to make use of scissors. Obviously such an instrument is convenient and time-saving.

Briefly, this instrument shows the needle-holder jaw that is superior when the holder is properly held in the right hand, to have a cutting edge that is slightly curved on the flat. This cutting edge is on the side of the jaw that would lie inferiorly when the right hand is rotated to the right. The other addition to the instrument is a scissor blade that fits the jaw blade in contour and has a shank with a finger holder that terminates just anterior to the finger holder of the needle-holder shank which accommodates the ring finger. In this way the middle finger fits easily in the finger holder of the scissor shank and



Combination needle holder and ligature scissors for use in right hand, a, scissor edge of holder jaw, b, scissor shank for middle finger, c, for ring finger, d, for thumb.

the operation of the scissors is carried out by the use of this finger after first locking the shanks of the needle holder by forcing them together. The scissor shank has a separate screw lock just anterior to the screw lock of the needle holder. Some bending of the scissor shank was necessary in order to bring the finger holder into the desired position.

The cutting edge and curve on the flat of the holder jaw do not affect its strength. The rim of the jaw is kept blunt and the scissor portion is not designed to reach the furthestmost end of the jaw. This with the scissors curved on the flat in addition, makes little likelihood of cutting any other structures when cutting ligatures. Furthermore its construction prevents the cutting of ligatures too short. I would add that the scissor blade is not made of a width sufficient to interfere with any needle held to the jaw of the holder.

This instrument is in no way more cumbersome or less serviceable than the ordinary Denver needle holder. In fact the additional holder for the middle finger enables one to operate the needle holder portion with greater ease.

The bringing of the scissor portion into play requires a bit of sympathy with this method of working and a slight amount of practice. Its

perfection means the saving of time when plying sutures (especially interrupted ones), and ligatures when it is necessary to use a suture.

This instrument would of course be of no advantage to a surgeon who leaves the cutting of sutures and ligatures to an assistant who would have less knowledge of the site to cut and must therefore be less perfect than the operator in this capacity.

The scissor blades have remained sharp as long as scissors ordinarily do and though not designed for it, will if necessary cut tissue, however they are not as satisfactory for this as ordinary scissors.

The instrument can be used in either hand though it is more satisfactory for one who is am-
bilateral to have an instrument made for each hand, with one instrument having the shanks arranged for right and one for left hand use (see illustration).

To summarize. The instrument described has all of the advantages of the Denver needle holder when used in such and in addition affords an entirely satisfactory ligature scissors without the inconvenience of either holding two instruments in the hand or laying one instrument down and picking up the other.

While still holding the instrument suture tying can be done without inconvenience.

PLACENTA PRÆVIA TREATED WITH PITUITARY EXTRACT

REPORT OF CASES

By PAUL GALLAGHER, M.D., EL PASO, TEXAS, AND HIRSH GALLAGHER, A.B., M.D., LOS ANGELES, CALIFORNIA

FROM the beginning of the practice of obstetrics, placenta prævia has been the complication most dreaded by the accoucheur. Not only has it been most dreaded, but it has been accepted in a spirit of almost total hopelessness for the child. From the time of Barnes (1) who gave us the best accurate description, or almost from that of Portal (2), in 1685, and Schlicher (3), in 1709 the subject of placenta prævia has been *in statu quo*. Maternal mortality varied from 1 per cent to 45 per cent, and, fluctuating with the series, fetal mortality was from 35 to 66 per cent, with the further expectation that fully 50 per cent of the children born alive, would die within the first ten days. This was a pretty hopeless outlook, particularly as we had come to believe that the chance for the mother decreased directly with our efforts for

the child. It was stated by Williams (4) that fetal mortality is not susceptible of any material reduction for the reason that the pregnancy is generally terminated before term when the chances for extra uterine life are relatively unfavorable.

The outlook has of late given way to a much more optimistic one. The advent of pituitary extract and its use in obstetrics is, in the opinion of the most recent writers on the subject, a decided step in advance. Certain practitioners feel that perhaps here is an agent which will help take from placenta prævia its present unfavorable and dangerous aspects. Among the recent observers of the results of the pituitary extract practically Hamm (5) only anticipates trouble from the use of the drug and that because of his unfortunate experiences when imbe-

ing labor prematurely. No other observer seems to have had the trouble which he reports of the formation of stricture in the lower uterine segment, and all seem to think pituitary extract, in the treatment of placenta prævia, the agent of choice.

The drug has been used in the treatment of 4 cases in my own work and it has proved of inestimable value. I have used several of the preparations on the market, all put up in ampouls, sometimes using two or more preparations in a single case. The results were uniformly good. The treatment was effective in all of the cases which is contrary to the results reported by Jacoby (6). However, its ineffectiveness should not be seriously apprehended since our position in that case could be no worse than before.

Vogt (7) says that experiences have been too few to give accurate indications as to the use of the drug, but he quotes Hofbauer (10), whose opinion concerning it is decidedly favorable. He cites one case in which rapid delivery caused a cervical tear through the entire wall of the uterus, with rupture of the uterine artery. This may have been due to large doses given too early. However, this case is the only one of the kind reported in a literature already becoming voluminous, and, without in any way dissuading us from the use of the drug, the incident has served to make us more guarded. Notwithstanding the fact that numerous "accident-less" cases are reported, the accident might happen again.

Sachs (8) has reported 16 cases. In 4 the results were good, in 4 fair, and in 4 bad. In the last 4 the pains had not begun when the drug was given. This seems to me a decided contra-indication, since the extract cannot be expected to initiate labor. Sachs further states that a slightly dilated cervix is a contra-indication. In discussing the extract, he gives placenta prævia as one of the indications for its use.

Puppel (9) advocates the use of the extract in combination with version. Hofbauer (10) speaks of its excellent service in placenta prævia, but adds that if half or more of the orifice is covered by placental tissue, he does a metrecure or combined version first. Hirsch (11) contributes a valuable point in touching on the need of several injections. One large dose cannot afford as good results as several small doses judiciously repeated. However, the time consumed in Hirsch's series, from 3 to 6 hours, seems to me too long and too fraught with the danger of bringing the method into disrepute by unfavorable results. I believe the time in his series could have been shortened with perfect safety and with more satisfactory results if the doses

had been a little more frequent and a larger dose had been employed when the cervix became easily dilatable or when dilatation was complete.

Hauch and Meyer (12) report among 6 others, one very successful case in which, besides placenta prævia, there was a prolapse of the cord with a very low insertion (3 cm. from where the membranes were torn) in a delivery three weeks before term. Four of the other cases were successful, 2 of placenta prævia totals were failures. Failure due to inactivity, maternal or medicinal, is described by Jacoby (6) only, who reports also one successful case.

Fuchs (13) and Fourmer (14) report favorable results, the latter of whom details a case in which the extract was not used until two and one-half hours after the first very severe hemorrhage. Nevertheless, successful delivery was accomplished seven and one-half hours after the beginning of labor.

The articles written by Gall (15) show his optimism and give the greatest hope for future development of the technique and the results. He says that results have been so good as to warrant further use of the drug. Out of 10 cases of placenta prævia centralis, all the mothers except one who was moribund when first seen, were saved. The fetal mortality in his cases was high but was explainable and did not reflect on the treatment. In these cases the fetal heart sounds were not distinguishable on the admission of the mother to the hospital. He believes the treatment best for both mother and child. No tears of the cervix nor any uterine strictures were noted in his series of cases.

Fischer (16) and Studeny (17) report results which amply justify for them this mode of treatment. Madill and Allan (18) combine the use of the extract with version, and Orta (19) with the use of Charpentier bags. In view of the other reports, however, this latter seems somewhat unnecessary.

Without citing any cases Quigley (20) gives placenta prævia lateralis as an indication for the use of pituitary extract. Trapl (21) has reported 16 cases with 3 stillborn infants. However, two were dead before the treatment was begun. The one death was unexplained, occurring 4 hours after the beginning of treatment. Trapl does not believe it was due to the extract, since he noted an increase in heart sounds after the beginning of treatment. He has moreover seen a living child delivered several hours after the sounds had become weak and irregular. He recommends that the extract be given regularly and be repeated if needed.

Druskin (22) cites two cases without comment. In one there was a good result for both mother and child and in the other a stillborn child. Anderson (23), in a discussion of pituitary extract, gives placenta prævia as an indication for its use. He quotes an early paper of Vogt (7) which recounts the successful results of its use in 7 cases.

Stratz (24) has stated in a recent paper that the child mortality in his cases without the use of the extract, is 45 per cent, while statistics for the whole Netherlands show 43 per cent for children and 7 per cent for mothers without the use of the extract, and according to the old methods of treatment. It seems to me that no greater argument could be offered for the use of pituitary extract in placenta prævia than Stratz's paper with its appalling statistics, as compared with the worst recounted under the new method of treatment.

The following are brief histories of my own cases:

CASE 1. M. A., age 30, V para, married 8 years. *Examination at term.* The patient was bleeding freely, the os dilated to about the size of a quarter-dollar, marginal placenta prævia, to the left side position could not be diagnosed, but the head was well down. At 11 p.m. pituitary extract was administered (½ cm). The pain increased and the bleeding became less. At 12:00 a.m. the dilatation and bleeding were increasing. One half cm. of the extract was given. At 12:30 a.m. there was less bleeding. At 1:00 a.m. dilatation and bleeding were increasing and the membranes were ruptured. One cm. extract was given. Very rapid delivery in the occipitotransverse position. The placenta was delivered in two parts, first, the size of palm, second, cord membranes etc. The condition was satisfactory. At the end of 6 months, the mother and child were both well.

CASE 2. J. M. de G., age 30, IV para, married 8 years. Pains began at 10 p.m. At 12:00 a.m. the patient was bleeding freely with pains about the same. Presentation and position were occipitotransverse-anterior. Right marginal placenta prævia ½ inch. Fetal heart sounds indistinct. ½ cm. pituitary extract was given. At 12:30 a.m. bleeding was the same. Dilatation about the size of a half-dollar. Pituitary extract ½ cm. At 12:45 a.m. bleeding was less, pains more severe, head descending well. At 1:15 a.m. there was dilatation about the size of a silver dollar. Bleeding was about the same. The membranes were ruptured. One cm. pituitary extract was given. Satisfactory delivery at 1:30. Infant slightly asphyctic. At the termination of my visits which was the last time I saw either both mother and child were well.

CASE 3. I. G. de E., age 24, married 7 years. Presentation and position occipitotransverse-posterior. The fetal heart sounds were very plain. The patient was examined one hour after the beginning of mild pains. There was some oozing. Left, marginal, placenta prævia. Gradual progress of pain and bleeding to severe bleeding. At 8:00 p.m. ½ cm. of pituitary extract was given. At 8:30 p.m. bleeding less and pains were more severe. At 8:50 p.m. pains were very stormy. At 9:00 p.m. pains were less, bleeding more severe. Dilatation was about the size of silver dollar. Patient given 1 cm. of pituitary extract

At 9:15 p.m. satisfactory delivery in membranes. Small child. Both mother and child well when last seen about a year later.

CASE 4. L. A. de F., age 20, VIII para, married 14 years. Upon examination no fetal heart sounds could be detected. Presentation and position occipitotransverse-anterior. The pains were weak. Placenta prævia overlapping left side. At 8:00 p.m. dilatation was about the size of quarter dollar. The patient was bleeding freely. She was given ½ cm. of extract. At 8:30 p.m. dilatation was about the size of half-dollar. The bleeding was less. At 9 p.m. dilatation and bleeding were increasing. She was given ½ cm. of pituitary extract. At 9:30 p.m. dilatation was proceeding. The bleeding was severe. The membranes were ruptured. One cm. of pituitary extract was given. At 9:40 p.m. expulsive delivery. The child was stillborn. About twelve months later the patient was delivered by a midwife of another child. Both are now well.

SUMMARY

For the treatment of placenta prævia in general I would recommend:

1. That everything be in readiness to do a version or metemuric as if necessary.

2. Pituitary extract should be used in small doses (½ cm.) repeated as needed during the latter part of the first stage, and followed finally by a large dose (1 to 1½ cm.) when the dilatation is complete.

3. Restrain impatience as regards the progress of the case but be advised minutely as to the preventing part and the condition of the mother in order to be ready for instantaneous interference when it is warranted.

4. Be prepared for emergencies which may require interference.

5. Be prepared for giving an intravenous saline in case of extreme loss of blood. The reduction of pressure consequent on the loss of blood, often kills these patients, and an intravenous infusion can be given even while parturition is in progress.

6. Be superlatively aseptic. It is my opinion that the relative rarity of infections in these cases is largely due to a "local parturition immunity" arising from the oedema and swelling with the cofferdamming of the tissue spaces. However, this does not warrant any varying from the strictest aseptic practice. While parturition is a physiological act every delivery is a surgical case in which the surgical work is carried on under the most adverse circumstances. Particularly is this true in placenta prævia and for this reason more care and more rigid asepsis should be the aim of every accoucher.

With the limited number of cases I have treated the results can hardly be considered authoritative, but they have been so exceedingly good that I have deemed it advisable to make this report for the benefit of those who may not have in-

tigated the literature on the subject, or who for fear of possible consequences, may be meeting the condition of placenta prævia with the old apprehensions and the old method of treatment

REFERENCES

- 1 BARNES, R. The Physiology and Treatment of Placenta Prævia. London 1837
- 2 PORTAL, P. La pratique des accouchemens soutenus d'un grand nombre d'observations. Paris G. Martin, 1685
- 3 SCHACHER, P. G. De anatomica præcipuum partum administratione
- 4 WILLIAMS, Obstetrics
- 5 HAMM, A. Hypophysenextrakt als Wehenmittel bei rechtzeitig und vorzeitigem Geburt. München med. Wchnschr., 1912, lix, 77
- 6 JACOBY, M. Pituglandol als Wehenmittel. Zentralbl. f. d. ges. Therap., 1913, xxvi, 1
- 7 VOGT, F. Geburtshülfliche Erfahrungen mit Pituitrin. München med. Wchnschr. 1911 lvi, 2734
- 8 SACHS, L. Weitere Erfahrungen mit Pituglandol in der Geburtshilfe, mit besonderer Berücksichtigung der Verwendung der intravenösen Injektion. Monatschr. f. Geburtsh. u. Gynaek. 1914, xl, 544
- 9 PUPPEL, E. Geburtshülfliche Indikationen und Kontraindikationen der Hypophysenpräparate. Monatschr. f. Geburtsh. u. Gynaek., 1913 xxxviii, 399
- 10 HOFBAUER, J. Die Verwertung der Hypophysenextrakte in der praktischen Geburtshilfe. München med. Wchnschr., 1912, lix, 1270
- 11 HIRSCH, E. Pituitrin in der Geburtshilfe. München med. Wchnschr. 1912, lix, 634
- 12 HALCH, E., and MEYER, I. Pituitrin als Austreibungs-

- mittel, besonders bei der Behandlung der Placenta prævia. Gynaek. Rundschau, 1913, vii, 132
- 13 FERRIS, A. Erfahrungen mit Pituglandol in der geburtshülflichen Praxis. Ztschr. f. Geburtsh. u. Gynaek., 1913, lvi, 517
- 14 FOURNIER. De l'emploi de l'extrait du lobe postérieur de l'hypophyse dans le placenta prævia, la délivrance à terme et la rétention placentaire postabortive. Bull. d'obst. et de gynéc. de Paris, 1914, iii, 375
- 15 GALL, P. Pituglandol in der Behandlung der Placenta prævia. Zentralbl. f. Gynaek., 1913, xxxviii, 334
- Indikationen und Kontraindikationen der Hypophysenextrakte in der geburtshülflichen Praxis. Gynaek. Rundschau 1914, viii, 304
- 16 FISCHER, O. Pituitrinwirkung in 50 geburtshülflichen Fällen. Zentralbl. f. Gynaek., 1912, xxvi, 15
- 17 SEDGWY, A. Bericht ueber die Anwendung des Pituitrins in der Bruenner Landesgeburtsanstalt. Wien. klin. Wchnschr., 1911, xxiv, 1766
- 18 MADILL, D. G., and ALAN, R. M. Use of pituitary extract in labor. Surg. Gynec. & Obst., 1914, xix, 241
- 19 ORR, J. H. Les extraits hypophysaires et le ballon de Champetier dans le placenta prævia. Rev. de esp. méd., Madrid 1913
- 20 QUEIGLEY, J. K. Pituitary extract in obstetrics. J. Am. M. Ass. 1915 lvi, 1222
- 21 TRAPF, G. Hypophysenextrakt in der Behandlung der Placenta prævia. Monatschr. f. Geburtsh. u. Gynaek., 1912 xxxvi, 393
- 22 DRUSKY, S. J. Pituitary extract in obstetrics. Am. J. Obst. 1914, lvi, 597
- 23 ANDERSON, L. I. Pituitrin in obstetrics. Buffalo M. J., 1911
- 24 STRITZ, C. II. Behandlung der Placenta prævia. Ztschr. f. Geburtsh. u. Gynaek. lxxvi, 677

THE TREATMENT OF FEMORAL ANEURISM

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THE purpose of this paper is to bring out some points in connection with the treatment of femoral aneurism which appear to be overlooked by many writers.

The time of operation is an all important consideration because if sufficient time be allowed to elapse between the date of the appearance of the aneurism and the operation, in most cases a sufficient collateral circulation will have been established to permit of the tying off of the vessel if the aneurism be below the point at which the profunda femoris is given off. Dr James Neff, in an article published two years ago in SURGERY, GYNECOLOGY AND OBSTETRICS, demonstrated the use of an arterial clamp which gradually occludes the lumen of the vessel thereby permitting time for the establishment of the collateral circulation. The importance of the element of time cannot be exaggerated for upon the collat-

eral circulation depends the life of the limb or even of the patient himself.

During this period of waiting for the establishment of the collateral circulation the patient should be kept absolutely in bed because of the danger of rupture of the aneurismal sac and secondly, because the further development of the aneurism is best retarded by rest.

The second important consideration in the treatment of femoral aneurism is the location. If the aneurism be situated above the point at which the profunda femoris is given off the condition is very greatly complicated. However, most writers agree that if the circulation be retained in the deep femoral artery the superficial vessel may be safely ligated.

Third, the choice of operation is not always left to the discretion of the operator, because the pressure in the femoral artery is high and the

conditions for plastic work, are far less ideal than in smaller vessels.

Aneurisms of the femoral artery are almost always caused by trauma, contrary to the development of these lesions elsewhere, which are so frequently brought about by specific infection and arterial disease. In the cases of femoral aneurisms seen in the past two years at the County Hospital all have been caused by gunshot wounds, the tendency being for the victim to endeavor to shield himself by turning sideways toward the bullet. In most cases the bullet has just grazed the thigh, or else penetrated the deep muscles and wounded the adventitia. The aneurism, of course, may also be caused by stab wounds, but this is rare.

The dissecting aneurism is the type most commonly produced, rarely the spindle-shaped tumor which is observed as the result of luetic infection. The heavy muscles of the thigh are raised up and frequently to some extent separated if the condition persists for any length of time. The patient complains of great pain which is worse when he exercises and necessitates frequent stops in attempting to walk. There is frequently cyanosis of the extremity and the temperature of the limb is lowered. The patient finally becomes entirely incapacitated for work and rapidly loses weight and strength because of his inability to sleep on account of the pain.

The case herewith reported is that of a Mexican aged 27 years who about sixteen months previous to operation was shot from the front, in the region of the left Scarpa's triangle. There was very little hemorrhage at the time, he could walk afterward but he suffered pain in the wound and remained more or less in his bed for two months. After this he had no trouble whatsoever, but there was no impairment of function in the left leg or hip. However, pain began in the same area five weeks before operation, with no injury just before. The pain came on gradually, was always pounding or throbbing in character and grew gradually worse. Soon after the pain began, a small swelling was noticed in the same area and this swelling increased gradually as the pain grew worse. Movement of the left thigh was impaired because of the pain and swelling, and the pain usually was referred down the inner thigh to the knee.

Examination revealed a tumor in the upper, inner aspect of the left thigh, semispherical in shape, with a distinct, visible, heaving, expansile pulsation synchronous with the heart beat. Expansile pulsation was easily palpable, there was a marked systolic thrill felt over the tumor on its lateral border near the region of the femoral artery. The mass was dull to percussion, felt hard but elastic, could be indented by pressure and was not very movable. There was a marked systolic bruit over the entire tumor and above and below the tumor for variable distances. It was most marked over the lateral border of the tumor, the entrance and exit wounds of bullet shot of last year. The hip-joints and knee-joints were normal, motion was unimpaired, and there was no pain. The patient walked

to the ward. The femoral pulse was delayed on the left side and slower in returning in comparison with the femoral above the pulsating mass.

Pathology. The aneurism was about the size of a large apple, situated just below Poupart's ligament and extending down about one-third the distance of the thigh. There was a very marked heaving, expansile throb together with a loud bruit. The aneurism had lifted up all the tissues above it and was causing the patient great pain. It has been increasing rapidly in size for the past month.

Operation. Operation was performed on June 11, 1915 at Cook County Hospital. A long incision was made from about the level of the umbilicus on the affected side downward over the course of the femoral artery as low down as the level of the patella. The abdomen was first opened, the peritoneum pushed up out of the way and a provisional ligature put around the external iliac artery. The common femoral artery was exposed just below Poupart's ligament and a provisional ligature carried around it by means of an aneurism needle, carefully pushing the femoral vein out of the way. At this point it was discovered that the aneurism came off the superficial femoral artery at a point one-half inch below the point of origin of the profunda femoris. A double ligature was now placed around the superficial femoral at just the point where the profunda was given off and a protective clamp was placed around the artery just above the aneurism.

The soft parts were now carefully dissected from the aneurismal sac and an effort made to isolate the distal portion of the femoral artery guided by the sartorius muscle at the point of emergence of the femoral artery at the opening in the adductor magnus muscle. It was found impossible to locate the artery below the aneurism so the aneurismal sac was opened. This contained a large quantity of fresh arterial blood and also black, clotted blood, which was carefully scraped out. Bleeding occurred from the distal portion of the artery at this time, which was identified by means of the hemorrhage. This was doubly ligated, close in the sac leaving this field quite dry. Only a small portion of the aneurismal sac was removed. The remainder was top sewed and left in place. No attempt was made at plastic work because the circulation remained good after the tying of the superficial femoral artery, as was evidenced by the bleeding from the distal portion and also by the fact that the femoral vein was quite full. The patient's foot and leg remained warm and he left the operating room with a pulse of 120.

The wound healed by primary union and the stitches were removed on the tenth day. The patient was allowed to walk about at the end of that time and left the hospital at the end of three weeks with perfect function in the affected extremity. The temperature of both feet was equal and there was no discomfort of any kind. To all intents and purposes he made a complete recovery.

CONCLUSIONS

1. It is advisable to allow ten days to two weeks to elapse between the time of injury and the date of operation.

2. Double ligation is the best method in aneurisms in this position. Great care must be exercised to ligate the distal portion after the collateral circulation is formed or severe hemorrhage will result.

3. The ultimate results of this type of treatment are good.

CORRESPONDENCE

FRACTURE OF THE NECK OF THE FEMUR

To the Editor I have read with pleasure and profit the paper by Dr. McGlannan on "Fracture of the Neck of the Femur," in the March issue.

I note with particular interest that 20 patients were treated by the abduction method with but one death, that in the remaining 19 bony union followed, and that the investigation of final results (from 9 months to 8 years afterward) in the cases available for examination (11 in number), showed 9 good results, or 80 per cent, which is quite out of comparison with any others that have been reported.

This record is of especial importance because it proves that fracture of the neck of the femur may be treated on surgical principles; namely, by immediate reduction of the deformity and by secure fixation of the fragments, and that the results, as in other fractures, are dependent upon the character and quality of the treatment.

In the description of the abduction method, Dr. McGlannan states that after the reduction of the deformity, the limb is placed in full abduction and slight flexion, that the other thigh is included in the plaster for security, and that a pad is placed behind the trochanter to assure inward rotation. This is not quite correct. The limb is placed in complete abduction and complete (hyper) extension, the other thigh is not included in the support, nor is a pad placed beneath the trochanter. Complete extension as contrasted with flexion increases the tension on the capsule which is the basis of security and prevents a sagging backward of the shaft fragment if the plaster spica becomes loose. The sound thigh is not fixed because to do so adds a burden and restraint which is unnecessary if the plaster is properly applied.

I am at a loss to understand how, in the face of the results of his investigation, Dr. McGlannan finds it necessary to describe at length a method of traction by ice tongs unbedded in the femur, a modification of traction by the Steinmann nail—a method which has all the disadvantages of ordinary traction, i.e. elevation of the foot of the bed, persistent pressure on the buttocks, uncertainty of

reduction and control, with the very doubtful advantage of a more direct pull with the limb in an attitude of flexion.

The same criticism may be made of the treatment in Class F, in which the thighs are abducted on a spreader, which is attached to the bed rail, and in which, by elevating the foot of the bed the traction of the body is supposed to reduce deformity and to assure subsequent security.

Traction treatment, of whatever type, is mechanically defective as a means of assuring the essentials of success. It has the further disadvantages of compelling rest, if not on the back, at least on the buttocks, where pressure is concentrated, usually with elevation of the foot of the bed. These disadvantages can hardly be compensated for by the occasional assumption of the sitting posture as a preventive of hypostatic congestion.

The abduction method is complete in itself. The head of the bed may be raised to any degree, and the patient may be moved at will and turned completely over without discomfort. There can be, therefore, no danger of hypostatic congestion, and bed sores, which are almost unavoidable under ordinary conditions, need never occur.

A comparison of the results of the abduction method, already referred to above, and those treated by the alternative methods described, is of interest. Of 9 patients, 2 died under treatment. In 3 cases the time was too short for report, and of the 4 others, 1 may be classed as a good result, although with a "rigid hip" (25 per cent).

The abduction treatment has been many times described during the past 14 years, yet at the present time it is not properly presented in any of the special treatises on fractures, consequently, its principles and its proper application are not usually understood by those who criticize it. Those who may wish to consult the original source may find one of the more recent descriptions in the *Annals of Surgery* for October, 1914.

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TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD JANUARY 7, 1916, WITH THE PRESIDENT, DR. S. C. PLUMMER,
IN THE CHUR

RECONSTRUCTION OF THE PYLORUS

DR. ALFRED A. STRAUSS. I want to show a method by which I have dissected one half of the pylorus and tried to reconstruct it with two superimposed fascial transplants. I have been impressed with the results that have followed this operation. The best results from gastric ulcer are in those cases in which resection of the ulcer can be made without gastro-enterostomy, and the question arose, could not the same principle be applied to the pylorus, provided there is some means of reconstructing its lumen. Considering the question from that standpoint I undertook an experimental study in trying to reconstruct the pylorus. Because of cicatrization of the pylorus in those cases in which the Heinecke-Mikulicz pyloroplasty is done the results are not satisfactory. There is some scar formation and usually a dilated stomach with its obstructive symptoms. Instead of this operation I supply a fascial transplant, by which the pylorus is quite easily enlarged to its normal size and lumen.

POST-OPERATIVE TETANUS

DR. KELLOGG SPEER read a paper entitled "Post operative Tetanus." (See p. 443)

DISCUSSION

DR. JOHN F. GOLDEN. To Dr. Speed's paper I can add a report of one case with deductions drawn from it.

In the first place, the treatment of tetanus is prophylaxis. After tetanus begins, I believe there is a consensus of opinion at the present time that there really is no efficacious saving treatment, that efficacious saving treatment is only the prophylactic treatment. The prophylactic and saving treatment of some of our cases of post operative tetanus, due to my experience with the case I am about to relate, is in determining what the cause of the tetanus is, whether it is from the intestinal contents or from the catgut used at the time of the operation. If tetanus develops in a particular case from the catgut, it seems to me we can save the other cases that were operated on at the same time by giving

all of them prophylactic treatment and by stopping the use of that particular catgut, or giving prophylactic treatment to the cases we immediately operate on.

Some two or three years ago, when Dr. Murphy left for a trip to Europe I had the usual number of post operative cases to look after. At that time I believe there were about ninety. Some of them were recently operated on. About two days after Dr. Murphy left one of my associates reported that one of the patients was having an attack of hysteria. I did not go over to the hospital immediately, but subsequently on making the rounds I came to this patient. She had a locking of the jaw but no temperature. She had been operated on some five days before and while she had only this locking of the jaw I made a diagnosis of tetanus. I telephoned the doctor who referred her to me, stating that his patient had tetanus and was going to die and, if possible, to come to the hospital. The patient five and one half days after the operation, had this locking of the jaw. The last seven hours of the first twelve we watched the patient very carefully. I had consultations with older men in the case and my diagnosis was not concurred in. The patient died at the end of twenty four hours, six and one half days after the operation. I attributed her condition to infection from within the alimentary canal. The operation was a simple one. I did not give the cases that were operated on that same day (there were five or six of them) a prophylactic dose of antitetanic serum. I went on operating that day and daily afterward without giving these patients antitetanic serum and used the same catgut. Some two or three weeks after Dr. Murphy's return he received in his mail a letter from a surgeon in Calcutta, India, warning him that the catgut he was using was the cause of tetanus in cases in India. Dr. Murphy looked the matter up and the catgut used in this particular case I have quoted was manufactured and sent out at the same time as the catgut that was used in Calcutta, India.

The prophylactic treatment, while, of course, not always efficacious, is generally so. We have had no case in which we have used antitetanic serum. It is the only efficacious treatment we have, and therefore when our cases develop post-operative

tetanus attributed to the use of catgut, we use only prophylactic treatment.

This is the only case I have had experience with, and it has taught me that it would have been a good thing to have given prophylactic treatment to the cases that were operated on at that time and to have changed the catgut on the cases which I continued to operate on in Dr. Murphy's absence.

DR. ROGER T. VAUGHAN: On November 2, 1915, a boy, six years of age, came to the Cook County Hospital in the service of Dr. Besley, with extensive injuries of the right leg and left groin, the result of being run over by a vehicle. The skin was stripped from his right leg most of the way from the ankle to the groin, and the sewing up of the wound was quite an extensive procedure. The fascia was exposed and, in places, the muscle, too. I was called to help the interne sew up the wound in the operating room. We mopped out the wound thoroughly with iodine and cut away all severely crushed and non-bleeding tissue, especially that with dirt ground in it. The next day the boy was given a prophylactic dose of antitoxin, fifteen hundred units. The following noon, November 4, the patient had a few convulsive twitchings in both arms, and these continued throughout that afternoon. Whether there was trismus or not, was a matter of dispute among those who saw him. I was not there that day, so I have to accept the report of others. At any rate, it was considered a case of tetanus by one of the doctors, and the two others who doubted this diagnosis because of the slight trismus and the unusual distribution of the convulsive movements, were unable to suggest a diagnosis of their own.

At first only some dead skin was cut away, but the convulsive twitchings in the arms becoming more frequent, finally under gas anesthesia amputation near the hip was performed, and shortly after this operation the patient died. The indication for operation was not only the suspected tetanus but also extensive discoloration of the leg which was believed to be the expression of an impending gangrene.

I have not run across any case of tetanus of only two days incubation period, and I should like to ask Dr. Speed if he knows of any such cases or if he has seen any go on to so early a fatal termination in spite of prophylactic injection of antitoxin. Traumatic fat embolism was considered but the onset of the symptoms seemed rather too late for that condition.

Not long ago in Cook County Hospital we had one post-operative tetanus case in a child. It came on two weeks after circumcision was performed, and the sutures used were not catgut but horsehair. We took specimens of the horsehair from the dressing room where the operation had been performed and from other dressing rooms and no tetanus bacilli were found in any of the samples. That boy recovered.

I saw another case of post-operative tetanus at the County Hospital six or eight months ago which

developed in the gynecological service six or seven days after an extensive repair of pelvic adhesions and went on to a fatal termination within 12 hours of the onset of symptoms. On that same day in the operating room, using the same catgut, seven or eight other operations were performed and this was the only case of tetanus that developed, and no cases have developed since then to my knowledge.

DR. DEAN LEWIS: I would like to ask Dr. Speed if in any of these cases he knows whether the spasms developed around the seat of the injury and if they were near also the point of infection? It is now recognized that trismus and spasm are the late symptoms of tetanus rather than the early ones.

I have not had any experience with post-operative tetanus, but I have seen one case which developed about sixteen days after an injury to the foot in which the spasms were limited to the nerve supply, or to the muscles supplied by nerves at the point of distribution about the site of the injury without any general spasm or trismus developing. So I would like to ask the doctor if in these cases he has seen them early enough to say whether there was local spasm which would give a clue to the site of infection.

DR. E. WYLLIS ANDREWS: The whole interest of this paper lies in the possibilities it opens up as to carriers in human beings who are subject, after intestinal or stomach operations, to tetanic infection. I would not have believed it possible *a priori* but one of these six cases reported by Dr. Speed occurred in my own practice. The patient was operated on, apparently made a good recovery, and died two weeks later with the onset of tetanus. We had made an intestinal suture, and the autopsy which was made by Dr. LeCount or Bissell showed tetanus organisms in the intestines and in the sutures adjacent to the bowel wall.

If the ordinary gastric and intestinal operation has this as one of its risks it is time we knew it and looked it in the face. Probably it is a risk, however slight, which no technique of preparation or operation can prevent.

DR. ROGER T. VAUGHAN: I think I can answer Dr. Lewis' question. In the clinic of Neusser in Vienna in 1907 I saw a case of local tetanus probably originating in a wound on the right foot. Both lower extremities were markedly spastic, the right more than the left. When I first saw the man, with a marked increase in the deep reflexes and with clonic spasms on percussion of the muscles. This spasticity extended from the legs up to the middle of the abdomen in the course of three or four or five days while the patient was being given daily doses of antitoxin. He never developed trismus, and this spasticity of the muscles never ascended higher than the level of the navel and, under antitoxin treatment gradually disappeared again in the reverse order of its onset. Stejskal, Neusser's first assistant at the time, made the statement that local spasticity with increase of deep reflexes, and clonic spasms on irritation is characteristic of tetanus and of no other condition. Since that time

I have been on the lookout for cases of local tetanus but have seen none, although I suppose I have observed about a score of tetanus cases of the ordinary type, but in the literature a considerable number of such cases have been reported. In only one of these cases I have seen was local spasticity a prominent feature and that was a case of right-sided head tetanus with a marked spastic facial paralysis as well as marked trismus. This patient recovered under massive doses of antitoxin. My impression is that local tetanus is a relatively mild but infrequent form of the disease. The only explanation which I can suggest for the difference between the two types of the disease is that the toxin perhaps spreads centripetally along the nerves in the local variety, but by way of the blood stream in the common variety with early trismus, and by both routes where trismus and local spasm are combined.

DR KELLOGG SPED (closing). I desired merely to call your attention to non traumatic, post operative tetanus, a form which occurs after a normal, perfectly clean operation.

The case Dr. Vaughan spoke of might have had tetanic infection sometime before from the bowel or from some other source, the cryptogenic or rheumatic form, which suddenly manifested itself after the injury. I do not know of any case of two days' incubation. The cases where the spasms are focalized in a limb or a group of muscles are the so called cases of local tetanus. If you will search the literature, you will find there are hundreds reported, and recently, since the European war, a great many more are coming out in reports. I have read of several such cases in this country. I called attention to these post-operative cases because they do occur sporadically here and there and you cannot do anything for them. The first thing you know the patient has tetanus and is beyond hope. If we cannot do something in a prophylactic way in emptying the bowel or giving serum to ward off these cases, I know of nothing curative after a severe onset with a short incubation.

After my perusal of the literature and studying the subject, I can hardly believe that catgut is the cause of these infections. The case Dr. Golden cited was a very strange coincidence and it would seem to refute that idea. It may have been a sheer coincidence that the surgeon in India had tetanic infection at the same time that Dr. Murphy had such a case. I hope you will never have one of these post-operative cases because they come out of a clear sky, and in spite of best efforts the patient will nearly always die if the incubation is of short duration.

REPORT OF FOURTEEN CASES WITH ACUTE PERFORATION OF THE STOMACH AND DUODENUM, WITH END-RESULTS

DR C. L. GIBSON, of New York City (by invitation), read a paper entitled "Report of Fourteen Cases With Acute Perforation of the Stomach and Duodenum, with End-Results" (See p 388)

DISCUSSION

DR ARTHUR DEAN BEVAN. I consider Dr. Gibson's paper a very valuable contribution to the subject of the handling of perforated gastric and duodenal ulcers. It is a clean-cut presentation of a recent group of ulcers operated on early, and certainly with remarkably good results. I agree on the whole with his conclusions.

I would like to emphasize one or two points first, in regard to the diagnosis. Dr. Gibson states that these cases operated upon very early will give a very low mortality—possibly not more than 5 per cent. I believe that is true. The trouble has been in the past that these cases have not been operated on early, because medical men have demanded too much in the way of symptoms. The diagnosis in these cases must be made very early, and in order to make it early we must make it on a few tangible, definite facts. These are pain, muscle rigidity, and tenderness. You cannot wait to find free air in the peritoneal cavity obscuring liver dullness. I have never seen a perforating gastric or duodenal ulcer yet with that sign, although Dr. Gibson states this sign is retained in almost all the literature. You can wait for an increased leucocyte count, seen early these patients may have 8,000 or 9,000 leucocytes, and a temperature of 99°. You must make the diagnosis early, or before you can make an accurate differential diagnosis. You must accept the fact that many of these cases will be diagnosed simply as acute upper abdominal accidents without presenting data upon which to make the differentiation between an acute pancreatitis and perforating gastric or duodenal ulcer, or between a gall bladder with perforation and acute gastric or duodenal ulcer. The diagnosis must be made with a clear understanding that it is a probable diagnosis of gastric or duodenal ulcer, but with a definite diagnosis that the patient has some acute abdominal lesion that demands an exploratory operation. I believe that if our medical men and surgeons will accept the responsibility of making these diagnoses early, much good would be accomplished but you know it requires a good deal of courage on the part of the medical man or surgeon to go into a family and urge that the patient be sent to a hospital in these early attacks and insist upon an exploratory operation, in the face of the facts that you have no data at hand that will make an absolute diagnosis for you.

In regard to the technique of management, I think Dr. Gibson is quite correct that ether is the best anesthetic if the patient is in a fairly good physical condition and is seen early. On the other hand, I am quite convinced that a number of these patients are best operated upon under local anesthesia, with possibly the addition during the more painful manipulation of gas carried on for a few minutes. I think morphine should be given in these cases, not as a part of the anesthetic, but because most of these patients have an enormous amount of pain. The morphine should be given

before the operation, as soon as the operation is determined upon, for the relief of the pain before and after the operative procedure.

My own experience has been just about the same as that of Dr. Gibson in regard to the number of cases and in regard to the technique. I have found almost all of these perforations in the duodenum and in the anterior surface of the stomach. In the cases I have operated on the perforations close to the pylorus were not of large size, as a rule, and where it was possible I have used a double purse string suture of linen or silk.

In regard to the handling of these cases so far as drainage and irrigation are concerned, I have some rather definite views. If the leakage has been small and definitely limited, I believe the best plan is to mop out the stomach or duodenal contents at that point. On the other hand, I have had several perforations that have occurred after a fairly good meal, and I think in these cases irrigation is absolutely essential, because the peritoneum does not bear very well Welsh rarebit, cheese sandwiches, etc. I could not take the view that these foreign substances should be left in the peritoneal cavity because that is very bad teaching. Almost all surgeons, I think, have come to the conclusion that in the fact of gross fecal contents, or gross stomach or intestinal contents, the peritoneal cavity should be irrigated thoroughly and in a way that will not lose any time, and this can be readily done. The peritoneal cavity in these cases should be washed out with normal salt solution, and large amounts of it at a temperature of about 105° or 110° . When it is recognized that irrigation is essential, a counter opening should be made above the symphysis, a large glass tube should be introduced and while we are putting in our purse string sutures to close the perforation or perforations, and normal salt solution should be allowed to flow freely through the entire peritoneal cavity through the glass tube.

These cases should be drained. Dr. Gibson says he has done away with drainage. I think that is probably a good thing where there is a limited amount or no extravasation. I believe, however, where there has been gross extravasation the patient is much safer with irrigation as described and with drainage. I have worked alongside of men who have not used irrigation in these cases, and I know perfectly well my statistics and my results have been as good and better than theirs, and I am satisfied distinctly better than those men who have not irrigated in perforating cases with the escape of large quantities of stomach contents.

Just one other point in regard to the after management and it is this. In the bad cases, where drainage is necessary, many of us for years have made a mistake in using the Fowler position. A modified Fowler position is much better, the patient being kept in a recumbent position, with the head of the bed elevated about two feet, so that we obtain practically the same benefit of gravity as we do in the Fowler position without sitting the patient up.

Another thing I am much impressed with is this. Where we have a bad case, and we feel that normal salt solution by the rectum is necessary, these patients are much more comfortable with the interrupted use of normal salt solution than by the continuous use of it. Eight or ten ounces, given every two or three hours to a patient, is a very much more comfortable procedure than continuous irrigation.

In closing, I want to emphasize the fact again, that I regard Dr. Gibson's clean-cut presentation of these facts as most admirable, especially from the standpoint that he has emphasized the uselessness of gastro-enterostomy as a routine, as practiced and emphasized by Deaver and others. Think of what a foolish thing it is to advocate doing gastro-enterostomy in every case of perforation of the duodenum or perforating gastric ulcer in view of the statistics Dr. Gibson has presented tonight. There is no logical reason in the world for combining gastro-enterostomy with the operative treatment of these perforations unless there is definite evidence of pyloric obstruction. Think of the added risk of gastro-enterostomy in the face of this septic field, especially with the evidence that Dr. Gibson has presented of the curative effect apparently of the perforation and its after management in a surgical way. Personally, I feel that an important step in the after cure of these cases is to give these patients the benefit of ulcer management. The same medical management that has proved to be so successful in the management of uncomplicated gastric and duodenal ulcer should be carried out here. I think that is true, even though Dr. Gibson's statistics are so admirable. Probably 20 per cent or more of these ulcers are multiple and because of that fact, if for nothing else, medical management becomes a very important procedure in the after treatment.

DR. JACOB FRANK. I have been very much interested in Dr. Gibson's paper and in the results he has obtained. There is one point he has not talked about, and all the authors whose contributions I have read have not paid attention to it, namely, whether there is blood in the abdominal cavity, and in some cases where there has not been any hemorrhage previous to the perforation.

I have a case under observation now which I operated on a little over two weeks ago in which there was a perforation near the pyloric end of the stomach large enough to introduce the thumb. It was easily recognized. The abdomen was filled with fluid. There was not the least sign of any blood in the abdominal cavity, not even in the immediate neighborhood of the perforation. No history of the patient having vomited blood previous to the operation was obtainable. The day after the operation, at which I approximated the edges of the perforation with silk and buried same with two rows of Lembert sutures, the patient began to vomit blood, and continued to do so for twenty-four hours. It was thought best to wash out his stomach. I was sur-

prised to see the amount of blood removed. I was almost afraid he was going to bleed to death, but after having his stomach washed he became comfortable and soon ceased vomiting.

In the light of this hematemesis I tried to reason out why it was he did not vomit before the perforation, or why there was no blood vomited at any time. The only thing I could figure out was that I must have pierced some of the blood vessels during the inversion of the ulcer edges. I would like to know from Dr. Gibson if in any of the perforations he has encountered he has found any blood in the abdomen?

In this case I did not wash out the abdominal cavity, but I made an incision over the pubes and introduced a very large drainage tube, and also drained the site of the operation. The patient is taking solids now. There has not been any leakage in this case, although in some cases I have had leakage. It might be of interest to know in what percentage of the cases leakage occurs. I know very well that if leakage does occur, healing takes place rapidly, it being almost impossible to keep the opening patulous.

I feel as does Dr. Bevan with regard to gastro-enterostomy. I know that Dr. Deaver recommends doing gastro-enterostomy, but I have not considered myself dexterous enough when a patient is almost moribund, to guard against more shock by doing a gastro-enterostomy. Moreover, I believe it is not necessary because all of the cases of gastric and duodenal ulcer I have had have recovered. I have in mind one case of almost fifteen years' standing, and I know of other cases of six or seven years' standing and in not one of them has recurrence taken place. That they must be careful about their diet goes without saying.

Dr. DANIEL N. EISENDRATH. I would like to ask Dr. Gibson whether in any of his previous series of cases, or in his present series, he has encountered any case in which it has been impossible to close the perforation. I have encountered two such cases, one gastric, and one a duodenal perforation, in which the tissues were so indurated that all attempts to insert a purse string or ordinary Lembert suture were of no avail, and it was necessary in the case of duodenal ulcer to suture a piece of gauze at the site of perforation. The patient recovered as though I had closed the perforation.

Dr. Bevan says that in some of his cases he would advise irrigation. Personally, I have abandoned irrigation, and I have had a relatively large number of cases of general peritonitis from appendicitis, about 60, and have had a fairly large number of cases of perforations from gastric and duodenal ulcer. I have yet to regret using the dry method, i. e., getting in and out rapidly. I think the sheet anchor which has saved a great many cases for me has been the establishment of suprapubic stab-wound drainage. That can be done in much less time than irrigation of the abdomen. As quickly as you close the perforation you place the hand

above the pubes and make a stab wound, and insert a "jacket" drain down into the cul-de-sac, and place the patient up in a modified Fowler position.

I agree with Dr. Bevan in regard to the interrupted use of proctoclysis. A great many of these patients cannot stand continuous proctoclysis. I have been in the habit lately, instead of using salt solution, of using simply six ounces of tap water, with about 2 per cent bicarbonate of soda, and 2 per cent glucose, to combat the acidosis in these cases.

Dr. Gibson's X rays are exceedingly instructive, if we can interpret the "imagination" of his radiographer, namely, that his closure of the perforation has been followed in a niche shadow in every case. His statistics are excellent, and the position he takes in regard to gastro-enterostomy is a good warning against its employment. This is dangerous in the hands of the majority of surgeons at the time of closing the perforation.

Dr. ALFRED A. STRAUSS. I would like to speak of the additional use of fascial transplants especially in those cases where a purse string suture is difficult to put in in cases of ulcer in which there is marked infiltration. As to the question of sepsis in connection with the fascial transplant, I would like to say that when the fascial transplant is attached with silk ligatures instead of with catgut, the transplant becomes adherent to the tissues to which it is attached in spite of infection and nearly all transplants which have been reported as having sloughed, if examined will be found not to have sloughed but that the ligature has sloughed. If these fascial transplants are attached with interrupted silk sutures in every perforating ulcer, especially those cases Dr. Eisenkrath referred to in which it is difficult to insert a purse string suture on account of marked infiltrations, an additional suture certainly would do no harm.

Dr. L. L. McARTHUR. I would like to ask Dr. Gibson in closing to tell us whether he has, in view of the recent bacteriological work done on the etiological factors of these stomach ulcers, had occasion to make cultures of the secondary abscesses that occasionally complicate these perforated ulcers.

In two cases (since the work of Rosenow and others have called attention to the peculiarity of the organism) it has been my fortune to recover the fusiform bacillus as a factor in the formation of such late infections, this being one of the organisms which is accused as an etiological factor in the formation of stomach ulcers. One of these was a late infection which perforated or extended through the diaphragm and made a septic pleurisy and the other a sub-hepatic abscess each of them containing pure cultures of the fusiform organism.

Dr. KETLOGG. I have operated on nine cases of perforating ulcer, one of which was carcinomatous. I take the liberty of speaking of them in order to ask Dr. Gibson a question. Of these nine cases only three recovered. The carcinoma

case died. Four cases were duodenal, and five were gastric. Two of the duodenal cases and one gastric case recovered. What struck me in the duodenal cases was the fact that the gall bladder in two cases was markedly distended, and in addition to closing the ulcer with purse string suture, I drained the gall bladder and both patients recovered. In another case the gall-bladder was agglutinated over the perforation site on the pylorus and acted as a seal.

One case came into prominence. The patient or his family claimed the ulcer of the stomach resulted from a trauma. He was a working man who fell over a wheel harrow, or was supposed to have done so, and death resulted from a perforating gastric ulcer. Under our State Compensation Act his family is now suing his employer for liability in connection with the death, and I wonder if in the discussion any one else would speak of a case where trauma was supposed to be the sole cause.

Four of my nine cases were characterized by a previous constipation. Two cases were preceded by attacks of diarrhea occurring at least two weeks before the time of perforation, and the thought struck me, in connection with what Dr. McArthur has said that there might possibly have been a secondary infection manifested by the diarrhea coming into the site of the ulcer which really caused the perforation?

DR. SYLVAN KUN. I would like to ask Dr. Gibson about how much water entered in opening the peritoneal cavity, and if there was much extravasation of stomach contents, would there not be likelihood of these contents being spread throughout the peritoneal cavity if he does not use drainage?

DR. WM. R. CLARKE. Doctor Gibson commented upon the fact that the liver dullness is never lost in these cases of perforating ulcer, although there is free gas in the peritoneal cavity. It seems to me that this would be explained by the intense rigidity of the abdominal muscles, which causes the costal arch to be drawn firmly down over the liver and the transverse colon. This also serves to wall the extravasated contents of the stomach or duodenum into the right hypochondriac region.

This symptom of a loss of liver dullness will occur in these cases but as a rule it occurs only when the case is moribund the abdomen greatly distended and the abdominal muscles paralytic. Therefore while this is absent in an early case, it is present in a late or moribund case.

DR. JAMES T. CASE. I have had the opportunity to examine only three cases of perforating gastric or duodenal ulcer after operation. In one of them gastro-enterostomy was done. In the other two it was not done. They all did very well. The emptying time after the gastro-enterostomy was less than three hours, in the other two it was normal.

In view of some remarks made by the speaker of the evening and several others present as to the

question of the correctness of the diagnosis, I would like to say something with reference to the probability of the arrows on the roentgenograms pointing to the real site of the ulcer. In many instances it is possible to recognize definitely the actual site of the ulcer by a little projection of the gastric shadow into the crater of the ulcer. If the shadow of the stomach is seen in profile, the site of the ulcer is usually made out very well. When the ulcer is on the anterior or posterior wall, I believe it is not always possible to determine the exact location of the lesion.

One of the chief difficulties in the diagnosis of ulcer by the deformity of the gastric or duodenal shadow which it produces is the fact that a similar deformity sometimes results from adhesions. The probability of the occurrence of adhesions after operation for perforative gastric or duodenal ulcer is very great, hence, while usually in gastric, and practically always in duodenal ulcer, it is possible to show a characteristic deformity due to the ulcer. Nevertheless, in post operative studies of patients, especially those who have been operated on for perforations, the likelihood of adhesions is very great, and I doubt if the areas indicated by the speaker's roentgenologist as shown in these slides, were always correct. We are hardly in a position to criticize this roentgenologist, for he surely did not draw his conclusions from the single plates which we have seen in the slides, probably in every case a number of plates were made.

DR. C. L. GIBSON, New York City (closing). I am very much indebted to the members of the society for their kindness and humane treatment of my paper. I am surprised there were not more objections raised, but the discussion goes to show that we are all working toward the same end. One or two things I have stated are not so much the result of my experience with this series of cases, because I have had quite a few more cases, beginning back in 1907, and the reason I did not give my whole experience was that I wanted to give the end results in this series of cases, and since I have become connected with the New York Hospital, a period of three years, I have kept those cases in mind and have been studying them, but until I had a hospital service which I could utilize to advantage I could not do this.

As to drainage I used to drain and wash out as Dr. Bevan does, but I had from 40 to 50 per cent mortality. Since I do not drain and wash out, I have had better results. As regards the medical management of these cases, it is only natural that we should carry it out. We treat these people with the best known therapeutic measures. I wish to say, however, that the so called medical cures of these ulcers are fakes. You have heard Will Mayo say, and I think most of us have had the same experience, that we do not operate on these cases of chronic ulcers until they have been cured medically a number of times.

As to the question of Dr. Frank with reference to

finding blood in the abdominal cavity, I have not seen it.

With reference to the question of Dr. Fisendraith, I know there are a great many difficulties attending the closure of the perforation in some cases, but I have been spared from having an experience of that sort. When I have such a case I think I will do as Dr. Fisendraith mentioned, use a piece of gauze and sew it in, unless I adopt the suggestion of Dr. Strauss to put in a fascial transplant. I am grateful to Dr. Strauss for that suggestion, and if ever I am so unfortunate as to need it, I shall remember that valuable hint.

In regard to the remarks of Dr. McArthur concerning cultures, I have not had an opportunity to verify them. We have had trouble in only one case, and that was an elderly man with a low grade

vitality, with syphilis, and who had infection of the abdominal wall. We did not make any cultures.

I cannot answer the question of Dr. Speed as regards distention of the gall bladder, but I am grateful for the description he gave and shall bear it in mind in looking at future cases.

With reference to Dr. Kunz's question about the possibility of infecting the peritoneum by opening under water, it is a small stunt. It is not necessary in the average case, but it is a little extra resource in finding the typhoid perforation the size of a pin prick. If I had not found the cause of the case related I would have closed the incision without searching for the perforation. There was no material extravasated. The perforation was found in the cæcum. There is not much danger of carrying in infection.

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD DECEMBER 17, 1915, WITH THE PRESIDENT, DR. CHANNING W. HARRETT, IN THE CHAIR

CANCER OF THE UTERUS

A symposium on "Cancer of the Uterus" was presented, in which the following papers were read.

DR. THOMAS J. WATKINS, Chicago: "The Prophylaxis of Uterine Cancer," (see page 413)

DR. HOWARD C. TAYLOR, New York City (by invitation): "The Radical Operation for Carcinoma of the Uterus." This article was read also before the Clinical Congress of Surgeons, Boston, October 28, 1915 (see p. 70, January, 1916, SURGERY, GYNECOLOGY AND OBSTETRICS)

DR. DONALD C. BARTON, Rochester, Minnesota (by invitation): "Discussion of the Relative Merits of the Operations for Cancer of the Uterus." This paper was also read before the Clinical Congress of Surgeons, Boston, October 28, 1915 (see p. 74, January, 1916, SURGERY, GYNECOLOGY AND OBSTETRICS)

DR. C. JEFF MILLER, New Orleans, Louisiana (by invitation): "Radium in the Treatment of Uterine Cancer" (see p. 417)

DR. JAMES T. CAST, Battle Creek, Michigan (by invitation): "Roentgen Rays in the Treatment of Uterine Cancer" (see p. 427)

DISCUSSION

DR. ELLI RIES: The radical operation, as I first described it in 1895 and as I practice it to-day, has never been given a real trial as far as I know, except here in Chicago. In my opinion a truly radical operation stands and falls with the thoroughness of the glandular dissection. Now if you look through the literature or look into the operating rooms you will find that the operators remove one

or perhaps three or four glands, at any rate an insignificant number in comparison with the minimum which normal anatomy shows. If a radical operation has been performed, the internal inguinal (at least three), the external iliac (at least three), the internal iliac (at least three), the common iliac (at least two), the obturator (at least one), the vena (at least one) glands must be shown on each side, a minimum of twenty-six (26). Who has shown them? I do not know of anybody outside Chicago. Therewith the discussion on the radical operation may end.

The so-called radical operation which is commonly described shows very little difference from the old Freund abdominal hysterectomy, when it comes to what counts really in a radical operation, namely, the amount of tissue removed beyond the original focus. The only difference is that the ureter is more or less exposed in this so-called radical operation, while it is avoided in the old Freund operation, a difference of not more than a quarter of an inch. Anybody who exposes the ureter first instead of beginning the dissection outside the ureter and continuing it inward toward the ureter is hopelessly handicapped for a thorough glandular dissection.

My results speak favorably for the operation. All of my patients who have survived the operation and who have had a complete operation (in some cases the operation could not be completed) are well and I receive their reports annually to prove it. They were operated on in 1898, 1899, and so on down to last year. I have lost track of the first case operated on in 1898 ten years after the operation when she last reported. The operative mortality is high around 25 per cent, but I have oper-

ated sometimes where the conditions were not favorable

I had hoped that the treatment of carcinoma of the cervix with radio active substances would fulfill the promises it gave, but I have been unable to see in this country any demonstration of results such as our European confrères have published. All the cases which I have turned over to the specialists in X-ray and mesothorium treatment are worse than when they started treatment, or dead. In the absence of clinical demonstration of cure by the radio-active substances, I wish to emphasize what Dr. Miller has brought out and what ought to be remembered when we look at the pretty pictures of cancer influenced by radio active substances. Degenerated areas of cancer cells prove nothing at all, for first of all every cancer shows degenerating areas along with its devastating progress, and secondly the complete destruction of more or less superficial areas after the radio active treatment proves nothing whatever as to what is going on in the depth. And in the cases which I have seen, progress in the depth has been the steady companion of the deceptive superficial effect.

DR. KOLISCHER. I have nothing to add to Dr. Ries' remarks about the abdominal radical operation. As to the employment of the actual cautery in cancer of the uterus, I would like to say this: one is justified in being rather doubtful as to the efficiency of this attempt at reviving this abandoned method. First, the extension of the heat in the depth beyond the area of application is rather limited, as one may readily convince oneself by testing the penetrating power of a Paquelin tip or of a soldering iron on a piece of meat; secondly, medical history furnishes strong arguments against the value of this method. Mackenrodt, for instance, dissatisfied with the vaginal hysterectomy for cancer, about twenty years ago used the actual cautery, first the Paquelin and then the soldering-irons for this purpose. After a prolonged trial he discarded this procedure in favor of the abdominal operation. If one really desires to coagulate tissues to any appreciable depth, diathermy has to be employed, which method permits of extending the coagulation to any desired depth. I am very much pleased with the conservatism displayed by Dr. Case in regard to the efficiency of X-rays in uterine cancer. In a general way, I would like to remark

that reports on the therapeutic value of the X-rays must be based on certain principal premises. Efficacy of the apparatus and completeness and reliability of the measuring outfit are paramount among these. The conviction that photometric tests are of little value in judging the therapeutic force of rays is constantly gaining followers.

The efficiency of the tube depends on its hardness, its constancy, and the quantity of usable rays produced. To measure the latter is only possible by the ionometer. It may not be amiss to mention on this occasion that the Coolidge tube, so enthusiastically hailed when put on the market, is rather severely criticized by some physicists as to its therapeutic value, on the ground that it cannot be sufficiently raised, and if raised to its limit, about eight Bauer, does not permit of a sufficient amperage.

That tubes that are cooled by running ice water invariably can be raised beyond ten Bauer under 5 milliamperes pressure and kept there during several hours of action can be demonstrated to anyone who would take the trouble of visiting the Radiotherapeutic Department of the Michael Reese Hospital.

As to the employment of radio-active substances I will have to admit that out of 57 cases of uterine cancer of various descriptions I am able to report only on 2 cases as successes, that is, both cases were inoperable cancers of the cervix, and in one after eleven, in the other after nine months' time, I am unable to find any evidence of disease. In the case mentioned by Ries, while locally epithelialization took place under mesothorium, at the left side of the portio a crater formed penetrating the parametrium. Ries lately cleaned that out and mesothorium was introduced into the cavity. I intend later to repeat this application. I do not expect a result in this case.

Judging from the reports coming from Europe concerning the mesothorium treatment of uterine cancers, and I have no reason to doubt statements made by men like Kroenig, Klein, Doederlein, Bumm, etc., I feel convinced that the superiority of their result is due to their refined technique which we must endeavor to acquire.

In conclusion I would like to mention that the overwhelming majority of these reports is based on the use of mesothorium and not of radium, the latter having been practically abandoned in favor of mesothorium.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

By MAJOR G. STEIG, M. D. St. Louis

PERHAPS it is referable to the European war and perhaps not, but surely there is a notably evident quantitative depreciation in medical books. Furthermore, perhaps this quantitative falling off is a good omen, signifying healthy contention, or perhaps an ill omen significant of the psychic influence of Mars. At all events, the truth of the matter is that during the course of the past two or three months the entire output of surgical volumes would not constitute a corporal's guard in even the most neutral of libraries. If the war is really the moving cause of the scarcity, and if men are not thinking or writing (surgically of course) because they are too busy fighting and dying, then one fearfully hesitates to contemplate the deluge of put up literature that will overwhelm us after peace is declared, and the flood gates of publication are reopened.

One is almost tempted to wish that instead of being obliged to contribute set reviews of definite and very concrete volumes, he might allow himself the liberty that that most excellent of literary reviewers, Francis Hackett, grants to himself. Mr. Hackett holds his department in *The New Republic*, "Books and Things," thereby relieving himself of all necessity of confining his comment to any special volumes. Unfortunately, however the medical reviewer may neither grant to himself nor have granted to him license or latitude. He must, perforce, do just as I am obliged to do this month: start off by saying that four books will be reviewed—all of them, by the way, command unusual interest—one of them purely surgical, one of them roentgenological, and one of them autolographical.

The purely surgical volume deals with the very recently developed and still developing field of bone grafts,¹ and never was the appearance of a volume better timed. We are right now in a period of renaissance of bone surgery, and we are in need of just the kind of volume that Dr. Albee has written, namely, one that deals with the fundamental principles underlying bone grafting, the specialized technique of making and inserting the grafts and the consideration of when and where to use the grafts. The book is made up of eight chapters devoted to the fundamental principles underlying

the use of the bone graft in surgery, the author's electric motor operating outfit and technique of usage, the bone graft in the treatment of Pott's disease and other lesions of the spine, the inlay bone graft in the operative treatment of fractures, operative measures for remodeling or ankylosing the hip joint, the inlay bone graft for fixation of tuberculous knee joints, infantile paralysis, osteoarthritis (Charcot's disease), the wedge graft for habitual dislocation of the patella, the bone graft in the treatment of diseases and deformities of the foot and leg, and miscellaneous surgical uses of the bone graft.

An adequate book review should be not only explanatory and critical, but also informative, that is, it should furnish the reader with information stimulated by the volume under discussion, but not contained in it. One cannot be informative in this sense of the word, in reviewing Albee's book, for he has embraced between both covers about all the information that has been furnished us by current literature. He has done this, moreover, in an admirably terse and concrete fashion. In the short space of thirty five pages he outlines the historical development of the subject of bone grafting, the histological principles underlying bone grafting, the nature of homoplastic, autoplastic and heteroplastic grafts, the bearing of Wolff's law on the growth of bone grafts, the rôle of the periosteum, various methods of preservation of bone grafts, and finally a tabulated list of all the indications for the use of bone grafts. It is interesting to note that Albee considers only two valid contraindications to the insertion of bone grafts, namely, a markedly septic field of operation, and extensive scar tissue as an environment.

The first chapter in which all the above subjects are touched upon is a remarkably good example of lucid, expository writing. On page thirty, the author succeeds in emphasizing all the elements essential to successful grafting in one not unduly long paragraph. He has a way of setting his reader right that is well illustrated by his forceful introduction of the subhead, 'The Rôle of the Periosteum,' which he opens with a sentence emphasizing the osteogenic nature of the periosteum and lends from this to the advice that "every graft should have as large a covering of periosteum as possible."

¹ BONE GRAFT SURGERY. By Fred H. Albee, A. B. M. D. FACS. Philadelphia and London: W. B. Saunders Company, 1915.

All his conclusions are stated with about this same degree of definiteness and yet, as a rule, without dogmatism, and there is throughout a healthful respect for the opinions and labors of other investigators. In a volume of this high character it would probably not have been amiss to have appended a complete bibliographic chapter, as a supplement to the many references furnished in the text.

The seven succeeding chapters are largely technical in character and constitute a practical *mode* *medium* to the operating surgeon. The fact that the methods described are, all of them, Albee's methods does not constitute a disadvantage, but rather furnishes that personal note of value indispensable in this type of book. To have dilated upon variations of method would have made the volume much less readable, and much less valuable, though possibly more encyclopedic in scope. No book was ever better illustrated or furnished better evidence of a real appreciation of the type of sketch necessary to illustrate steps in technique.

NOW and then, in the past, it has been necessary to call a consultation in order to do full credit to a volume of borderland surgical significance. Once again we resort to a special court, and submit the following judgment by Dr. R. Walter Mills, on the volume by George and Leonard¹ (*Roentgen Diagnosis of Surgical Lesions of the Gastrointestinal Tract*) and the short review, by Dr. Clifford G. Gruel, on the latest volume of the *Reference Handbook of the Medical Sciences*.

"The very great interest at present evinced in gastro intestinal surgical radiology finds its first American expression in textbook form in a combined textbook atlas volume by George and Leonard. The authors are to be congratulated on their courage in attempting to submit a view of a field so rapidly extending its boundaries. Where so many ideas and methods are striving for precedent in the construction of a subject, it is not surprising that the authors advocate with unqualified abandon one system of gastro-intestinal radiology in this case that of a modified serial plate method. The entire volume finds its motif in the enthusiasm of the authors for this method to the prejudice of the time honored radioscopic or combination radioscopic and plate methods. The strength of the book also its weakness, lies in this. It is not difficult to trace the origin of this position to a development from Cole's original teachings of a practical and exceedingly valuable method of plate diagnosis of the majority of duodenal ulcers—a method that has been developed through the work of the authors and their co-workers. Extreme partisanship for this plate method leads the authors to statements that are both very radical and not altogether unassailable. For instance, that the roentgenographic method alone serves to show defects and that the

continental school is based on a somewhat uncertain combination of clinical symptoms and varied roentgenoscopic manifestations of motility." This statement is made in spite of the fact that the filling defects of gastric carcinoma, the evidence of penetrating and callous ulcer, and of the form and position of the stomach in cases of pyloric obstruction and the like, originated in the roentgenoscopic method. Again the statement in the preface to the effect that the authors have "found the clinical evidence to be so superficial and inaccurate, that they have practically eliminated from the text the whole clinical story" is certainly an extreme position when one considers the peculiarly characteristic anamnesis of duodenal ulcer, esophageal carcinoma, colonic obstruction, and similar lesions. At least it might be anticipated that the authors would acknowledge the value of clinical findings as of economic importance in directing their roentgenological efforts. Another position that will not be supported by a very considerable number of radiologists is the valuelessness of the six hour residue as an indication of impaired gastric motility. Such evidence is contrary to the experience of workers of high standing, basing their observations on a study of a large material and using practically the same opaque media as the authors. This discrepancy, it may be suggested, is possibly due to the fact that George and Leonard examine their cases when not absolutely fasting and allow a "light meal" during the interim between the initial and the six hour observation.

"On the other hand the volume is of exceptional worth in presenting the value to be derived from a careful consideration of properly exposed plates from intelligently posed patients, in considerable numbers. The work will make a strong appeal to those who have questioned the value of gastro intestinal radiology, and to those who are not informed as to its accomplishments, and it will do this because all conclusions are reached from a consideration of X ray findings alone, possibly this is not the means of utilizing most fully the possibilities of the X ray in diagnosis, but nevertheless it is a method that makes a powerful argument. The chapter on radioscopic of duodenal ulcer marks a new epoch. In the chapter on the X ray diagnosis of gall stones the authors again take an extreme position as to the diagnostic effectiveness of special plate technique and inspection. Their optimism is not shared by many other workers.

The conscientious citation of operative findings in practically all cases, with due appreciation of those not so confirmed and the comparison of such data with the original X ray conclusions is most gratifying. The book is beautifully printed and is illustrated profusely with positive reproductions of roentgenograms very evidently selected from a considerable material. The roentgenograms are mostly of admirable quality. It is to be regretted that the water-colors and tone drawings hardly attain the same excellence.

¹ THE ROENTGEN DIAGNOSIS OF SURGICAL LESIONS OF THE GASTRO INTESTINAL TRACT. BY ARTHUR W. GEORGE, M.D. and RALPH D. LEONARD, A.B., M.D. Boston: The Colonial Press, 1915.

"THIS" continues a most useful set of books. Practically everything in medicine is covered in this particular volume, the article on lymphatics and lymph nodes is specially worked up in detail with some very good illustrations. The lymphatics of all the different organs are minutely described and shown. There is a long article with list of instruments on mastoid operation. Medical Licensing Boards and Medical History come in for their share. Other conditions are handled with much the same degree of completeness."

THERE, may be, in the minds of some, a very legitimate doubt regarding the appropriateness of including an autobiography, and a non surgical autobiography at that, in the book review columns of a purely surgical journal. But it has always seemed that surgery as a science should correspond to that most admirable definition of science furnished by President Huxley, who said "Science is not a department of life which may be partitioned off from other parts, it is not the knowledge of certain kinds of facts and the observation of certain kinds of interests, as distinct from other facts and other interests, it is a way of looking at life and dealing with life, a way of finding out facts of every kind

and dealing with interests as varied as the world itself."

"Where each I see the joy of working, and each in his separate way
Shall draw the force as he sees it, for the Good of things as they are."

If we agree to accept this broad definition, then we may brave all cashing and say just enough about this autobiography by Trudeau¹ to make every one of our readers experience the inner need of reading it. I know of no other medical autobiography just like it, this is essentially so because Trudeau (as he says in his foreword) "has drawn his soul"—a soul picture as distinguished from a man picture—and no approximate counterpart to Trudeau's soul has ever lived in human body.

Never was there a more poignant expression of the doctrine of fate conquered by acquiescence, never a more modest or more detached recital of a really great achievement against withering odds, never a more infectious breathing of the love of out-of-doors, of family, and of friends. The book fairly radiates the doctrine of loss of self in an effort of high purpose, and teaches the lesson of optimism in such pervasively subtle fashion as to clutch the heart of even the casual reader. There are no swashbuckling pitchforks on happiness at any cost, none of the usual dogmas of *per aspera ad astra*, but just a simple, straightforward, touching recital of hopes, struggles, buffets, joys, and victories. No man may read the book and fail to face his own daily problems with calmer spirit and saner determination.

¹An Autobiography by Edward Livingston Trudeau, M.D. Philadelphia and New York: Lea & Febiger, 1915.

²A REFERENCE HANDBOOK OF THE MEDICAL SCIENCES EXTRACTS FROM THE LANCET RANGE OF SCIENTIFIC AND PRACTICAL LITERATURE AND ALLIED SCIENCES. By various writers. Third edition, completely revised and rewritten. Edited by Thomas Lister, M.D., F.R.C.S. Eight volumes. Vol. VI. Lea & Febiger, New York, Philadelphia and Co. 1914.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

A TREATISE ON THE PRINCIPLES AND PRACTICE OF MEDICINE. By Arthur F. Edwards, A.M., M.D. Philadelphia and New York: Lea & Febiger, 1916.

OBSTETRICS—A PRACTICAL TEXTBOOK FOR STUDENTS AND PRACTITIONERS. By Edwin Bradford Cragin, A.B., A.M. (Hon.), M.D., I.A.C.S. Assisted by George H. Ryder, A.B., M.D. Philadelphia and New York: Lea & Febiger, 1916.

A TEXTBOOK OF NERVOUS DISEASES. For students and practicing physicians, in thirty lectures. By Robert Bing, Dozent of Neurology, University of Basel. Translated by Charles L. Allen, M.D., New York: Rebman Company, 1916.

WITH THE RED CROSS IN FRANCE, THE AFTERMATH OF

BATTLE. By Edward D. Toland. New York: The Macmillan Company, 1916.

STURGICAL OPERATIONS WITH LOCAL ANESTHESIA. By Arthur L. Hertzler, A.M., M.D., Ph.D., F.A.C.S. Second edition. New York: Surgery Publishing Company, 1916.

THE MEDICAL CLINIC OF CHICAGO. January 1916. Philadelphia and London: W. B. Saunders Company, 1916.

POST-MORTEM EXAMINATIONS. By William S. Wadsworth, M.D. Philadelphia and London: W. B. Saunders Company, 1915.

BANDAGING. By A. D. Whiting, M.D. Philadelphia and London: W. B. Saunders Company, 1915.

THE CLINIC OF JOHN B. MURPHY, M.D., AT MERCY HOSPITAL, CHICAGO. December 1915, IV, No. 6. Philadelphia and London: W. B. Saunders Company.

NETRO BY HYPO: A PRONOUNCED TONIC FOR THE PHYSICIAN. By Edwin P. Hawthorth. Kansas City, Missouri: The Willows Magazine Company.

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SURGERY, GYNECOLOGY AND OBSTETRICS

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A REPORT OF A SERIES OF UNUSUAL FÆCAL AND GENITO-URINARY CASES TREATED WITH BISMUTH PASTE¹

By EMIL G. BECK, M.D., F.A.C.S., CHICAGO
Surgeon, North Chicago Hospital

POST-OPERATIVE fæcal and urinary fistulæ as a rule heal spontaneously. Whenever they do not heal, the cases will usually resist all forms of treatment and continue to discharge urine or fæcal matter for months or even years. Such cases are often complicated with supuration, causing in addition multiple sinuses. The patients are unable to keep themselves clean, often become invalids, and beside their suffering, are a source of worry to relatives and to the surgeon. No wonder they are willing to submit to all sorts of operations which give them the slightest ray of hope for recovery.

I bring this subject now before the profession because of the difficulties in treating such cases, and secondly because my brother, Dr. Carl Beck, and I, during the past eight years have had the opportunity of treating a series of these apparently hopeless cases by means of *bismuth paste* in conjunction with other surgical treatment. Our results have been so satisfactory that we believe we now can offer some suggestions by which these obstinate cases can be cured.

Our series consists of 38 cases, 17 post-operative fæcal fistulæ and 21 cases of the genito-urinary tract. Of the former (fæcal fistulæ), 12 were the simple type following appendectomies, and are not cited here in

detail, although they were treated with bismuth paste. The remaining 5 cases of fæcal fistulæ are given in detail because each case teaches some practical point. Of the latter group, 21 cases of sinuses of the genito-urinary tract, all are given in detail and illustrated either by single or *stereoscopic roentgenograms*. They represent a large variety of conditions with which the genito-urinary specialist has had the greatest difficulty and it is hoped that many useful lessons will be learned from reading the histories and treatment employed.

Before citing the cases, I wish to give my present views on the causes, the prevention, and the most efficient treatment of fistulæ of all types, because the fæcal and genito-urinary fistulæ are often combined with chronic suppurative sinuses.

First of all, it must be remembered that a fistula is nothing more than a contracted abscess cavity. An abscess, after being evacuated, will shrivel and leave a long tortuous channel, beginning at the focus of the disease, and frequently will open at a great distance from its original source.

This can be seen in a large number of cases, which I shall illustrate by one case of unusual interest.

CASE 1, F. A man 53 years of age developed what was thought to be a pararectal abscess twelve years ago. It was incised and a fistula remained

¹ Read before the Chicago Surgical Society, December 3, 1915. (For discussion see p. 629.)

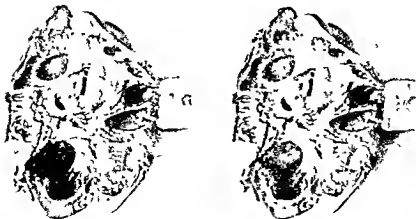


Fig. 18. Specimen of cystic kidney shown in Fig. 17. Location of cavities.

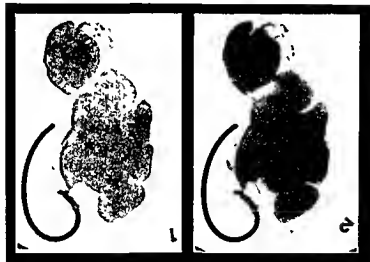


Fig. 17. Cystic kidney injected with bismuth. Note relative position of cysts.

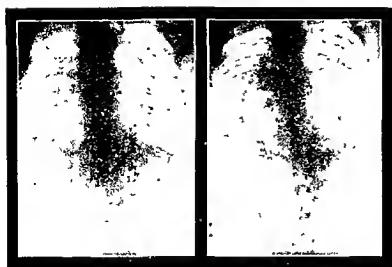


Fig. 9. Bronchial fistula following empyema and bronchial twig injected with bismuth, also perinephritic abscess localized by wire screen.

TECHNIQUE

The method, as I have already described in previous publications, consists of injecting a quantity of bi-smuth paste (*liquefied by heating in a water bath*), with a glass or metal syringe, into a sinus until one feels reasonably certain that all ramifications have been filled. The paste thus injected, will rapidly thicken and remain in the sinuses long enough to enable us to take a radiogram. Such radiogram will show us a true picture of the hidden labyrinth of channels and will often lead us to the focus from which the disease originally started. In many instances it will reveal errors in our previous diagnosis and consequently change our treatment.

It will require but little persuasion to convince even the most skeptical of the diagnostic value of this method. A perusal of only a few cases cited in this paper will teach us its advantages. We will recall instances in which such a radiogram would have been of great assistance and might have spared many a useless operation.

Formerly, we relied upon the probe or the injection of colored fluids as pathfinders of sinuses, but these only served as guides during the operation, while with this method we are able to make a more correct anatomical diagnosis before an operation is decided upon, and thus discriminate between operable and non operable cases. If an operation is necessary the procedure can be carried out with greater thoroughness and precision as we have definite plans before us.

When the sinuses are very long and tortuous the paste should be injected *in a liquid state*, so that it will flow readily into every part of the sinus tract. If there is more than one opening, the paste is likely to escape from the nearest opening and thus miss the remaining channels. To avoid this technical error the mouths of all the other sinuses should be compressed by an assistant placing the finger tip against it so that the liquid will follow its course in other directions filling up the path of the sinuses. *It is essential that every crevice should be filled at one injection* otherwise there will be a recurrence of suppuration.

Great care should be taken not to inject too large a quantity into large pus pockets and

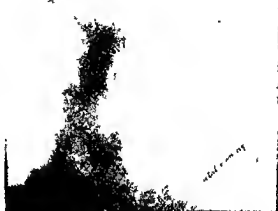


Fig. 1. Suppurated rectal fistula which proved to be an abscess resulting from tuberculosis of eleventh dorsal vertebra.

allow it to remain for too long a time, because of the possibility of absorption of bismuth which is likely to produce bismuth intoxication and even fatal poisoning. This complication can easily be prevented. In the North Chicago Hospital we were fortunate in not having a single fatal case in our series of 1800 cases. However I observed a case of very early bi-smuth poisoning in an empyema during the early period of this treatment but I was able to check additional absorption and save the patient. This case was reported in the *Journal of the American Medical Association* January 8 1900 and is the first case on record. I warned the profession against the indiscriminate use of the paste. It is fortunate that most of these accidents were at once reported in the literature. This has put on guard those who thought that bismuth was an entirely harmless substance. My publication and the reports of others who were unfortunate enough to have this complication must have had a very good effect because nearly all the cases of poisoning re-

During the next twelve years he had three extensive operations for rectal fistula. The result was an incontinence of feces. During the past two years he was confined to bed, a helpless invalid.

I saw him in July 1913, in London, Canada. He had been on a cot for nearly two years. The discharge was so profuse that he had to be dressed three or four times a day in order to preserve a semblance of cleanliness. The rectum was gaping open so that one could inspect about four inches without a speculum.

A week later he came to Chicago from Canada. I injected the pararectal sinus with bismuth paste and took a radiogram. This revealed that the apparent rectal fistula originated in the eleventh dorsal vertebra and caused a large network of sinuses in the abdomen. The radiogram showed clearly that this was a case of tuberculous spondylitis with a psoas abscess opening near the rectum, and not a rectal fistula.

Figure 1 illustrates clearly the origin of the disease, as well as the many branches of the sinuses.

After three months' treatment with injections, the patient left the city with forty pounds gain in weight, and able to walk.

The formation of sinuses usually takes place in this manner. When an abscess is formed the pus pushes its way in the line of least resistance and undermines the tissues in various directions by its increasing pressure, until it has reached a place near the skin or some hollow organ, where it breaks through and empties its contents. Usually it will run beneath the muscle sheath and fascia, opening at some distance from the original focus. In one of my cases a psoas abscess opened above the clavicle and the sinus was mistaken for a broken down tubercular gland in the neck.

After an abscess has emptied its contents, a shrinkage of the cavity takes place and a network of sinuses remains. This when shown in the radiogram will often cause great surprise as to its dimensions. I illustrate this point in Fig. 2 (a network of sinuses resulting from a hip joint disease).

At times small abscesses will lock themselves off and will empty their contents into different regions and thus result in multiple openings. I have seen as many as forty openings as a sequence of a knee-joint disease.

Sinuses frequently empty their contents into the bowel or bladder. At the same time the sinuses may have numerous openings through the skin and may discharge fecal

matter, urine, or both. I cite several such cases in this report.

The second point I wish to make is that most sinuses are due to secondary infection of cold abscesses. *Secondary infections can be prevented by injection of a 5 or 10 per cent bismuth paste*, immediately after incision of the cold abscess. In a series of over 200 cases treated by me, I have been able to prevent secondary infection in 98 per cent; only 4 of the entire series had a fistula.

If, however, a sinus remains, owing to secondary infection, through the fault of either the patient or physician, then we possess means of treatment, which I have shown to be successful in at least 65 per cent of cases of all types, and usually without any radical surgery, namely, by the injection of *bismuth paste*. The percentage of results are not taken from my own clinic, but from the average obtained by all surgeons throughout the world. They refer to the usual run of cases, such as hip joint disease, spondylitis, etc., without such complications as urinary fistulae or facial fistulae.

In cases where abscesses open into the bladder or the rectum, the same process of their origin holds true. This fact is contrary to the opinions of some that a fistula burrows its channel through the tissues from an ulcerative focus to the point of exit. In cases in which a urinary fistula is complicated by a discharge of pus, the results have been very satisfactory. As the suppurative sinuses yield to the injections, a tendency for closure against the urinary leakage is also accomplished. Cases of non-suppurative urinary fistulae, which have no natural tendency for closure, do not yield so readily to the bismuth treatment. For some reason the constant discharge of urine through the fistula renders the walls unfavorable to cicatrization. Such cases require either the actual cautery or strong caustics, and in some cases surgical intervention.

Since I am to confine my remarks to cases complicated with fecal or urinary fistulae, I shall show what can be accomplished in these cases by comparatively simple means, but before citing cases, I wish to say a few words on the technique, which is most essential to obtain good results.

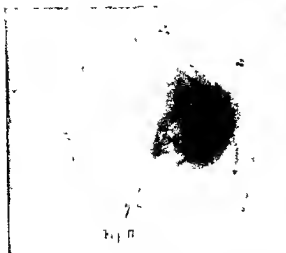


Fig 3. Rectal and faecal fistulae originating from hip-joint disease, left ischium absent

to pass through its natural channel and the fistula will gradually close, at least, this has been my experience

It is customary with us when a faecal fistula follows an operation to wait at least two weeks for spontaneous closure. By this time if the fistula has not entirely closed, it is usually narrowed down to small caliber and then the injections are instituted at intervals of one or two days. Just enough paste is injected to fill the sinus without an excess into the bowel. No attempt is made to pack the sinus with gauze, but merely an external dressing is placed over the wound. There is no irrigation necessary before the injection. In fact it is contra indicated.

Following the above rules of treatment, we were not obliged to resort to secondary operations, as the cases have either healed spontaneously or have closed subsequent to injections of bismuth paste.

I shall now cite in detail five more cases of faecal fistulae, since each of them teaches some practical point in the diagnosis and treatment of this class of cases.

CASE 2, F. Post operative faecal evacuation through abdominal incision, closure following bismuth injections.

Mrs. Rose J., age 36, married 20 years, no children, suffering from pyosalpinx for many years and run down in general health. Operated on by Dr. Carl Beck, July 19, 1909. The bowel was firmly

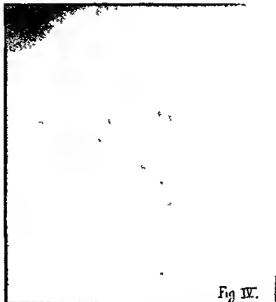


Fig 4. Faecal fistula following appendicitis, under minding muscles

adherent to the tube and was torn in several places. Resection of the bowel at that time was impossible.

For the following five months all the faecal matter was expelled through the abdominal incision, none passing through the rectum. December 14, 1909, she returned to the hospital for resection of the bowel but owing to an accident to her husband the operation was postponed. The patient was emaciated, weighing only 68 pounds, and a poor risk for operation.

At this time I began applying bismuth paste in faecal fistulae, and tried it in her case, injecting first very large quantities into the bowel through the abdominal wound, which was wide open and still discharging all the faecal contents of the bowel. To my surprise the wound began to contract and within three weeks narrowed to a pinhead opening through which only gas escaped. The contents of the bowel now passing through the rectum.

The patient began to recuperate, gaining 50 pounds in the first three months after this treatment was instituted, and her present weight is 189 pounds. (The patient exhibited before the Chicago Surgical Society shows the wound is closed; there has been no reopening in the past five years; she feels perfectly well and is able to work in spite of the hernia.)

Points of interest. Closure of large opening in the bowel without surgical interference. Unusual gain in weight.

CASE 3, F. Faecal fistulae, following resection of bowel, bismuth treatment, closure.

F. E., age 50, physician. Operated upon by Dr. Carl Beck on May 5, 1914, for removal of the lower part of the sigmoid, on account of a total obstruc-

Fig I



Fig 2 Network of sinuses resulting from hip-joint disease

ported occurred in the first two years, 1908 and 1909, and none appeared in the literature in the past year although the bismuth treatment is now employed more extensively than before.

It is gratifying to know that the poisoning can be prevented and if it accidentally occurs and is discovered in time, it can be checked before it causes irreparable damage.

PREVENTION OF BISMUTH POISONING

The prevention consists in not allowing large quantities of the paste to remain in the body for too long a period of time on account of its gradual absorption.

Should the symptoms appear, the paste must be removed by washing out the cavity with warm olive oil. The sterile oil should be

injected and retained from twelve to twenty-four hours, in order to produce an emulsion with the bismuth mixture. This emulsion should be withdrawn by means of a catheter or suction syringe. After its removal all symptoms will promptly disappear. Scraping out the paste with a scoop is a dangerous procedure, because it opens new channels for absorption.

FÆCAL FISTULÆ

In fecal fistulæ we should use the paste of a thicker consistency, so that it will not run into the bowel but will fill out the usually wide channel and prevent the escape of fecal matter. The consistency of the paste is regulated by heating the mixture. In wide gaping fistulæ it can be used without heating.

It is well known that as a rule the post-operative fecal fistulæ have a tendency to spontaneous closure, especially those of the large bowel. The fistulæ from the small intestine are more serious and more difficult to heal. If the mucous membrane of the bowel protrudes above the skin, the bismuth paste is not applicable. If, however, a fecal fistula is deep and communicates with the exterior through a long channel, the injection will be of great service. When the fecal fistula undermines the tissues before it reaches the external opening and a large area or sac is constantly filled with fecal matter, the bismuth paste is indicated.

It is a fortunate circumstance that precisely in those cases where operations are very difficult or impossible, the paste is of excellent service, while in those cases favorable for operation, the paste is of comparatively little value.

I am often asked what is the *modus operandi* which brings about this rapid closure of the sinuses and fistulæ? I believe it is due to a sterile medication brought in contact with the walls of the sinus or pocket, instead of having them soiled constantly with fecal matter. This cleansing process permits healthy granulations to form, which gradually obliterate the space previously filled with fecal matter.

If the technique is properly applied, and all recesses are filled, the fecal matter will begin

Point of interest When fecal matter is prevented from filling the channel, if only for a few days, the chances for closure are greatly facilitated

CASE 6, F Fecal fistula ten months, bismuth injection, closure

M A., age 25, family history negative In the fall of 1903 she was operated on for gangrenous appendicitis A fecal fistula resulted and persisted for four months A second operation failed to close the fistula It was then treated for six months with silver nitrate cauterization, without improvement In August, 1906, we took a radiogram after an injection of bismuth paste It demonstrated the uselessness of our silver nitrate treatment because of the existence of a cavity which undermined the muscles for an area of two inches in diameter (Fig. 4) The first injection was sufficient to obliterate this fistula Six years later the fistula closed (Case reported in *Journal of the American Medical Association* 1909)

Comment The second operation could probably have been spared had the bismuth injection been used

GENITO URINARY FISTULÆ

Fistulæ of the genito urinary tract originate in two ways More frequently they occur after operations or injuries of either the bladder, the ureters, or the kidneys Less frequently they originate from some disease in the neighboring organs causing perforation into the bladder, with the escape of urine



Fig. VII.

Fig. 7 Gonorrheal pyonephrosis, nephrectomy followed by sinus, bismuth injection, closure

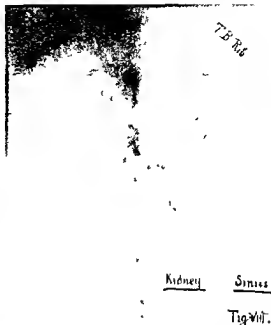


Fig. 8 Perinephritis and multiple abscesses in the back, treated with bismuth paste closure Later complication, malarial fever, fatal termination

through one or more sinuses instead of the natural channel

These sinuses may discharge either clear urine, pus, or urine mixed with pus We know, for instance, how frequently after the removal of a tuberculous kidney a sinus persists in discharging pus for months or even years Again post-operative fistulæ may result after pro-tatectomy, and such fistulæ will discharge urine and pus for an indefinite period

I shall cite one case where urine discharged through sinuses around the hip This condition was the result of a hip-joint disease, which had extended into the region of the bladder and perforated the same, so that all the urine escaped through the suppurative sinuses around the hips, instead of through the natural channel

The most favorable genito-urinary cases for treatment by injections of bismuth paste are the cases in which a suppurative sinus has persisted after a nephrectomy All cases of this type which came under my care during



Fig 5. Injected pus cavity of kidney with structured ureter

tion of that part of the bowel due to a solid growth. On account of the situation of the tumor an anastomosis could not be made at once and a colostomy was performed.

In July a second operation to establish the normal action of the bowel was performed, which left facial fistula which had no tendency to close and continued to discharge in three different places in the region of the incision.

This kept on until the latter part of November, 1914 when I injected bismuth paste for a period of five weeks at intervals of two or three days. All three facial fistula closed and there was no recurrence up to this date.

The patient's general condition is first rate.

Points of interest. Three facial fistula injected through one opening. Closure in five weeks.

CASE 4. Hip joint disease causing pararectal abscess and facial fistula: twenty years suppuration, closing of facial and suppurative fistula with bismuth injections.

Mr C. T. H., age 30, had right hip joint disease since childhood. In 1893 he was operated on and the necrosed head of the femur removed. Several sinuses leading to the hip joint remained, which kept on discharging for the past 20 years and required dressing twice a day. His general health was naturally very much deteriorated.

In January, 1913, he felt a swelling in the perineum and pain in the rectum. On account of high temperature and much pain I opened this abscess outside of the anus and a large amount of pus was evacuated. Inserting my finger into the cavity small speculae of bone were removed.

I noted that this cavity communicated with the bowel higher up and discharged a large amount of milodorous pus mixed with fecal matter. This fecal mixture kept discharging for weeks so that a semblance of cleanliness could not be maintained.

Bismuth injections were begun and the closure of the fecal, as well as the suppurative rectal channels, was accomplished in a remarkably short time. He gradually improved in general health but all the sinuses did not close. Injections were repeated at intervals of a month, and small speculae of bone extruded themselves from time to time. At present he reports that only one sinus near the hip is open, discharging only a few drops of serous material, and that he is able to work on the farm.

Figure 3 illustrates injected sinuses.

Points of interest. (A) Radical surgical interference in such a case is strictly contra-indicated. (B) Small sequestra are frequently the cause of continued suppuration. (C) Hip joint disease may at times cause pararectal abscesses and may be mistaken for a rectal fistula.

CASE 5. Post-operative fecal fistula: six months. Closure after first injection of bismuth.

C. A. I., age 21. At fourteen had a typical attack of appendicitis and a recurrence six years later. On January 31, 1909, he was operated on by his physician, who found a gangrenous appendix, and part of the cecum had to be resected, drainage for seven weeks then closure. A week later the wound reopened and fecal matter kept discharging until July 1909 (six months), at which time he came to me.

An injection of bismuth paste made in July resulted in complete and permanent closure of the fecal fistula within one week after the injection. It is closed to the present time.



Fig 6. Post-operative sinus following nephrectomy injected with bismuth.





Fig. 10 Network of sinuses in a bilateral perinephritic abscess

relieved of the source of a large quantity of toxins and the existing high degree of immunity is powerful enough to cope with the balance of micro organisms still operating in other parts of the body.² In other words it is not likely that during the development of the disease the degree of immunity keeps pace with the progress of the disease and that the sudden removal of a part of the diseased tissue leaves the system a sufficient degree of immunity to combat the remaining quantity of disease in the body.³

CASE 3 G U Sinus following removal of tuberculous kidney through peritoneal route bismuth injection closure.

Miss R T age 23 family history negative illness began May 1912 with frequent urination without pain no temperature or loss of weight. In July she had chills temperature up to 102 blood in the urine and loss of weight indicating serious trouble.

A diagnosis of tuberculous kidney was made and on August 17 1912 a nephrectomy of the right kidney through the abdominal route was performed by Dr Carl Beck. This permitted the examination of the other kidney which was normal but the right proved to be tuberculous and secondarily infected with abscess formation. The ureter was tuberculous but was not resected. It was ligated off with strong silk the ends of ligature were left outside of the incision and drainage established.

A great deal of pus kept discharging without a tendency to decrease until March 8 1913 (seven months) and daily temperature persisted. The sinus was injected with bismuth paste. March 8 and ten days later the wound was entirely closed and the extensive eczema disappeared.

The patient recuperated with great rapidity gained 27 pounds and is in perfect health.

Point of interest The constant temperature per-



Fig. 11 Pyonephrosis. Pus pockets of kidney injected through lumbar sinus showing the filling of same and the passage of the bismuth into the bladder. The sinus closed and pus disappeared from the urine after ten injections.

sisting for months disappeared with the first injection.

CASE 4, G U Post operative sinus following nephrectomy discharging seven months, injection closure.

Miss M servant age 30 gives history of having had a nephrectomy in the fall of 1907, which left a suppurating sinus.

March 8 1908 I injected the sinus with bismuth paste which shows a small cavity in the old kidney bed and an extension of the sinus running upward beneath the twelfth rib (see Fig. 6).

Another injection was made a few days later and the sinus closed. One year later it was still closed. Since then I have lost track of her.

CASE 5 G U Gonorrheal pyonephrosis nephrectomy followed by sinus bismuth injection closure.

Mr J S age 27 cutter consulted Dr Carl Beck September 27 1908. Complaints of pain in left kidney for one year. Denies specific history but had chronic gonorrhea for just four years. All symptoms pointed to stone in the kidney but radiogram was negative.

October 3 1908 the kidney was exposed. Large and congested. It was incised and no stone found but the kidney could not be entirely removed from its bed on account of infiltration. It was partly broken down during manipulation with con-



Fig. 12 Tuberculosis of kidney, sinus treated without nephrectomy, cure

able bleeding, and the portions removed showed complete degeneration. Without removing the entire kidney the cavity was packed tightly. The temperature rose to 104° and after a few days a large amount of pus and urine escaped from the wound. Since then he passed a large amount of pus in his urine. Gonorrheal germs were found in the pus.

Twenty days after the operation the temperature was normal and remained so, but the sinus kept suppurating profusely.

On January 25, 1909, about three and a half months after the operation the first injection was made (see Fig. 7). The pus discharge ceased in a few days and within two weeks the sinuses closed and remained so up to date.

Comment. Bismuth paste was effective in gonorrheal infection of the kidney.

CASE 6, G. U. Perinephritic abscess, fistula injected with bismuth paste.

Mr. M., age 31, farmer, family history negative. Had typhoid fever and three attacks of appendicitis.

In October, 1908, he began to complain of pain in the back and had daily temperature of 101° . In December of the same year he was operated on for appendicitis. The appendix was fibrous and an abscess was found about the right kidney. It was opened and drained through the back. The wound continued to discharge pus.

Six months later I examined him again, found two fistulae discharging pus. Cultures show staphylococci. Radiogram indicates a sinus leading into

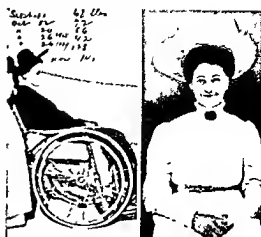


Fig. 13 (at left) Patient weighed 68 pounds in September, 1908.

Fig. 14 Present weight 148 pounds, two years later.

the kidney. Six injections at intervals of two days were given. Discharge diminished. By July 21, 1909, both sinuses were closed, no pain or fever was noted.

In 1911 the patient writes that he is not entirely well but did not state whether sinuses reopened.

CASE 7, G. U. Perinephritic and multiple abscesses treated with bismuth paste, closure. Latr., malarial fever, fatal termination.

Mr. M. F., age 26, lawyer. At 22 had an attack of pleurisy, followed by (what was thought to be) a subphrenic abscess. Diagnosis being uncertain, operation was postponed. Two months later an abscess was opened between the liver and lung. This kept draining but he recuperated and attended college for a year (1912). In June, 1913, he was operated on in Memphis for the sinus. Although this operation was extensive, the suppuration persisted. He was then sent to Fort Collins, Colorado, where he gradually improved in general health.

Another abscess formed in the region of the right kidney, about four inches lower than the sinus. This abscess was opened and drained and also continued to discharge. Bismuth treatments were instituted in Colorado and the discharge decreased considerably. September 1914, another abscess formed on the opposite side in the region of the left kidney. An operation was performed in Colorado, which resulted in a third sinus.

I first saw the patient in November, 1914. The three sinuses were injected and radiogram (Fig. 8) shows a perinephritic abscess on the right side, which stereoscopically viewed shows that the entire kidney was surrounded by a network of suppurative channels. There were numerous sinuses along the spinal column but the vertebrae did not show any signs of disease. The injection on the left side in the kidney region indicated that here too the ab-

cess was perinephritic. Two more abscesses developed during the early part of 1915, one originating in a tubercular rib on the left side in the back and the other from a tubercular rib in front. These were incised and treated with bismuth, and closed within a week or ten days. The remaining sinuses closed and the young man improved gradually in health, so that he left for his home in Mississippi.

After remaining one month in his home town (a hotbed of malarial fever) he suddenly developed paroxysms of chills and high fever, and returned to Chicago in a deplorable condition.

After a thorough examination no retention of pus could be found anywhere and all sinuses were closed. The patient was put on large doses of quinine, which seemed to control the chills and temperature to some extent. At first no malarial organisms could be found in the blood, but later these were discovered. The temperature kept on daily from 101° to 104° for three weeks. By this time he had become very much emaciated, deeply jaundiced and the liver enormously enlarged. Consultations were held and Dr. W. A. Evans confirmed the diagnosis of malarial fever with liver abscess.

On September 6, he expectorated about a pint of pus, the temperature remained around 97° until the next day, when he expired with symptoms of asphyxiation. Post mortem was not permitted. Cause of death was pronounced to be malarial fever, with secondary abscess in the liver, rupturing into the bronchus.

CASE 8. Lung abscess and bilateral perinephritic abscesses following submucous resection.

C. C., age 23, August 15, 1914, had a submucous resection in Ogden, Utah, with great loss of blood. Two weeks later he had a severe pain in his right chest and for the next three weeks he was confined to bed with fever but no cough. In October, 1914, an abscess formed below the scapula which ruptured spontaneously and kept discharging pus until May, 1915, when he was taken to Salt Lake City for treatment. Two ribs were resected and better drainage established. A month later an abscess formed in the region of the right kidney, which was opened and drained.

In September 1915 he came to me for treatment. I found the patient very much emaciated, one sinus draining from the right lung, another from the right kidney. There was a bulging abscess in the region of the left kidney distinctly fluctuating.

A bismuth paste injection of the fistula in the chest proved that the abscess in the lung communicated with a bronchus. This is clearly seen in the stereoroentgenogram Fig. 9. It shows the right bronchus filled with bismuth and also a twig of bronchioles in which the bismuth was forced during a coughing spell. There was more positive proof than the radiogram that the communication with the bronchus existed, the patient expectorated some of the paste immediately after it was injected.

In this radiogram we also notice the injection of the bismuth paste in the right nephritic abscess.



Fig. 15 Collargol



Fig. 16 Bismuth

Fig. 15 Collargol injection into cystic kidney, before operation.

Fig. 16 Bismuth injection into cystic kidney after its removal.

To estimate its depth, I have placed a small wire screen on the skin as a land mark, and it is very instructive to study this stereoroentgenogram from this point of view.

The abscess in the left kidney region was opened, injected with bismuth paste, and shows a multilocular abscess of great extent (Fig. 10). Unfortunately this abscess was already infected, so that it could not be classed among the cold abscesses and treated accordingly.

Here we have a complicate case, a lung abscess with bronchial fistula and double perinephritic abscess.

The injections were kept up for six weeks, the discharge diminished and the patient gradually improved. The sinus in the chest closed, but I decided to send him for the winter to the mountains in Wyoming, where his physician continues the injection of bismuth with the climatic advantages and sunlight treatment.

The latest report I have from his physician is that he has gained two pounds in weight and the sinuses are discharging less.

CASE 9. G. U. Pyonephrosis, draining four years, sinus and abscesses injected with bismuth paste, closure without nephrectomy.

Mrs. N. G., age 45, married, two children, both living. In 1905 the patient had bladder trouble, frequent urinations, pains radiating to the inner side of the thigh, no hematuria. This persisted for years.

In July 1909, she had chills, fever, pain, and swelling in the left loin. She was operated on August 30, by her physician for abscess of the kidney and a cupful of pus was removed and a drainage tube inserted. She had cough and night sweats thereafter. Since then she has had an offensive and profuse discharge from the sinus of the kidney and pus in the urine.

In November, 1913, my examination revealed a tumor the size of the head of a newborn child in



Fig. 20. Paravertebral sinus and rectal fistula, originating from hip joint disease. Single radiogram (receptive).

the region of the left kidney, painful on pressure. A stereoscopic radiogram after injection of bismuth paste gave a most interesting finding (Fig. 11).

The injections were repeated at intervals of two weeks for six months. The patient gained in weight (40 pounds) the tumor has reduced to nearly the normal kidney size and the sinus has remained closed up to the present. The urine is free from pus and albumin and she is entirely well.

(The patient was demonstrated at the Chicago Surgical Society.)

(Case 10, G. C. Tuberculosis of kidney without nephrectomy, bismuth injections, closure.)

Miss N. C. age 26 was well until 1907 when she fell from a buggy and slightly hurt her back. After two months of liver pain in the back and emaciation an abscess formed in the lumbar region. The abscess was opened whereupon secondary infection took place. For one year she was confined to bed running a daily temperature of one to three degrees and was reduced to a mere skeleton weighing only 76 pounds.

July 16, 1908 she was brought to me. In the excruciating lumbar region there were two sinuses secreting quantities of greenish pus. These two sinuses communicated as proved by the bismuth injections. On account of the painful condition I could inject only small quantities of the paste. A radiogram proved that this case was tuberculosis of the kidney, the vertebral column being perfectly normal.

Between July 15 and September 9 the sinuses were injected sixteen times without the slightest benefit. The fever continued. On September 9 I used a little more force than usual during the injection and felt as if something had given way. I could then inject three times the usual quantity.

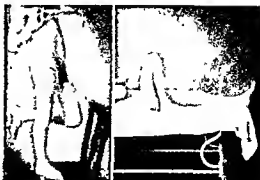


Fig. 21. A and B exhibit patient supporting his weight on the healed out tuberculous hip. Flexion and Extension.

Another radiogram after this injection (Fig. 12) plainly shows that the paste reached the kidney. After this injection the temperature fell to normal the secretion changed in a serum consistency. After five subsequent injections the sinuses were entirely closed. The patient could be taken into the fresh air in a rolling chair and began to gain rapidly. Figure 13 shows her one week after closure of sinuses when her weight was only 68 pounds. Within one year her weight was 120 pounds and she is now in perfect health which can be illustrated by her present photograph (Fig. 14). Her present weight is 145 pounds.

(Case 11, G. C. Large cystic kidney, nephrectomy, bismuth injections, closure.)

Miss H. R. age 17 occupation switchboard operator. Fell twelve years ago, and broke her leg. Since childhood she has "wet the bed." Present complaint. Every two or three weeks has pain in her left side in region of the kidney. It recurs regularly lasting two or three days. It radiates toward the epigastrium (micturition regular and normal). Urinary examination cloudy, acid, 1,020, no albumin or sugar, pus none plus.

Cystoscopic examination December 10, 1914 shows a normal bladder, functioning right kidney, but no urine could be seen coming from the left ureter although it appears normal.

Pyelography at this time shows a normal right sole and a dilated atonic ureter on the left side. The pelvis of the kidney did not show nor the calyces on the left side.

On January 6, 1915 it was possible to introduce a catheter sufficiently high so that 250 ccm. of colloid fluid was injected. Phosphotungstic phosphoric acid at this time showed from the right side 95 per cent appearing in three minutes from the left side 5 per cent which appeared in six minutes. Knowing that this left kidney would have to be removed very shortly 60 ccm. of collargol was injected. Radiogram (Fig. 15) gives a clear picture of the pathological condition present, namely, a group of multiple cysts filled with the injected material.



Fig. 23. Para-urethral fistula, injected with bismuth paste through the urethra.

Three days later the patient was operated on by Dr. Carl Beck. Langenbeck incision. The kidney was found markedly increased in size, especially the upper pole. It was found that the pelvis of the kidney was adherent, making it necessary to clamp the pedicle. The wound was closed in the usual manner drainage being left in the lower angle of the wound. The wound did not close as readily as expected and bismuth paste was injected to determine the depth of the sinus, which healed very rapidly following injection. The specimen (picture of which is shown here) shows that there had been a kinking of the ureter. The kidney on section shows a marked destruction of the parenchymatous tissue with cyst formation.

For the comparison of collargol injections in cystic kidney cases in the future, we have made the following experiment. The removed kidney was injected through the cut end of the ureter with liquefied 33 per cent bismuth paste until the pressure within the kidney indicated that the cavities were completely filled. The end of the ureter was then ligated to prevent the escape of the paste. A stereoradiogram was taken and compared with the radiogram taken before the operation with collargol injection (Fig. 16). The contour of shadows in both pictures is so strikingly similar that we can rely on the collargol injection in cystic kidney as a most valuable diagnostic adjunct. We illustrate this injected excised kidney by stereo roentgenogram (Fig. 17) to show the relative size and location of these cystic cavities and to compare them with the specimen itself. We have photographed the incised kidney shown in the stereo roentgenogram (Fig. 18).

Comment. This case is from a diagnostic standpoint an excellent example for study of cystic kidney and the method led us to a correct diagnosis and consequently the proper treatment.



Fig. 24. Kidney abscess gravitating into pelvis, discharging pus and urine.

CASE 12 G. U. Hip joint disease complicated with fecal and pararectal sinus and paravesical abscess, closure after bismuth injections.

C. A. age 26 well to the age of 14, when he suddenly developed a severe pain in the right knee. A day later the pain shifted to the hip. Diagnosis rheumatism (?) Abscess in the hip followed and was opened at home, drainage tube inserted, and a secondary infection took place. Two years later he was operated on in Iowa City. After operation the sinus remained closed for five months but spontaneously reopened. Thereafter sinuses appeared in different regions of the hip and finally a pararectal abscess formed which was opened and drained.

He came to me in January 1912. The right limb was about three and a half inches shorter than the left. Bismuth paste was injected and after three injections all sinuses closed. Two weeks later the patient could walk around without crutches which he had not done for years. He remained well for two years but in December 1913 suddenly developed a severe pain in the region of the lumbar vertebrae. He kept on getting worse the pain extending anterior to the bladder. He had frequent urination vesical tenesmus and great tenderness over the bladder. He returned to Chicago immediately and I found a bulging over the old pararectal scar. I incised the same and evacuated about a pint of reddish pus, which was mixed with fecal matter. It was thus evident that communication must have existed between the rectum and this abscess.

The injection of bismuth revealed a most instructive condition which is illustrated in stereo roentgenogram (Fig. 19). The paste filled out all the pararectal sinuses which originated from the old hip joint disease and communicated with the same.

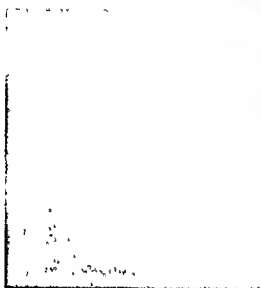


Fig. 26 Sinuses following nephrectomy, injected, closure

There is a side branch which through a narrow channel turns forward, anterior to the bladder and fills up a cavity about three inches long and about an inch wide. This can be observed only in the stereoscopic radiogram (A single plate gives rise to a false interpretation—see Fig. 20).

After two more injections the secretions became serous, fecal matter as well as pus stopped discharging and the patient regained his health with unusual rapidity and is perfectly well today.

Comments. The instructive features in this case are as follows. It proves that hip joint disease (1) can produce a fistula around the bladder and is likely to perforate into the bladder, (2) that a fistula which opens near the rectum may originate in the hip joint, (3) that such cases as this may be regarded as inoperable and still curable by this simple method of injection, (4) there is one remarkable phase of this case, namely, that in spite of the entire destruction of the hip joint he has perfect motion and normal strength in his limb. There is a shortening of about three and a half to four inches. He can stand on the affected limb as long as he can stand on the sound one. There is the same amount of flexion as in the healthy limb, although the entire head of the femur has been destroyed and absorbed. Pictures Fig. 21 A and B demonstrate this clearly.

CASE 13, G U. Urinary sinuses due to tuberculosis of prostate.

Dr. L. B. C., age 41, developed in 1901 bilateral pulmonary tuberculosis. He was treated in a sanitarium and a year later his pulmonary trouble was complicated by a deep perineal abscess. The latter was drained and a suppurative urinary fistula re-



Fig. 27 Infected urinary sinus following nephrectomy. Bismuth injections cleared up infection. Urinary discharge continued.

sulted, discharging for ten months. It healed spontaneously and remained closed for nearly seven years, and the pulmonary trouble had also improved. In July, 1900, the urinary fistula reopened and discharged pus and urine freely. This abscess had also opened into the rectum but the testicles remained normal. There was an enlargement of the prostate, so that he had to be catheterized. The tumor of his prostate, about the size of a lemon, was removed in a New York hospital, but the rectal, as well as the urinary, fistula remained.

In May, 1912, he came to me for treatment. There was one fistula on the left side of the scrotum and another two inches posterior to the anus, both discharging urine and pus. Besides these two external fistulae there was an intracutaneous sinus discharging urine.

All fistulae were injected with bismuth paste (Stereocoincidencegram Fig. 22 shows that all communicate with the bladder).

After repeated injections the pus discharge diminished but the urine continued for some time, but the fistulae have finally closed and at present the patient is perfectly well.

CASE 14, G U. Urinary fistula through prostate with coexisting para-urethral fistula. Bismuth injections, closure.

R. A., age 29, had scarlet fever at 4. One month later fell from tricycle on right hip. Within a month all symptoms of tuberculosis of the hip developed and he was radically operated on. The head of the femur was resected. At the age of 7, the hip was entirely healed, with considerable



Fig. XXVIII

Fig. 28. Tuberculosis of hip causing 16 urinary sinuses. No urine passed through urethra for 7 years previous to injection.

shortening and ankylosis and he had to walk on an extension shoe.

In November, 1908, at the age of 22, patient had pain in the rectum and a discharge of blood and pus. This continued for four months. February 25, 1909, a radical operation was performed on the perineum for abscess of the prostate. Two months later another abscess appeared anterior to the rectum which was opened and discharged pus and urine. This kept discharging until July, 1909, when I made a bismuth injection through the fistula which proved that there was a communication with the bladder. A radiogram shows the path of the fistula through the prostate into the bladder. Following this injection pus and urine stopped discharging and patient remained well up to this date.

In this case there also existed for years a small para-urethral fistula just back of the glans penis which discharged pus constantly and resisted all forms of treatment. I injected the paste in liquid state into the urethra, first applying a rubber constriction around the base of the penis, thus filling the urethral canal completely and the paste found its exit through the small fistula. Then I took a radiogram of the penis which illustrates the position of the fistulous tract (Fig. 23).

The therapeutic result was most satisfactory, inasmuch as the fistula closed within a few days and has not reopened.

CASE 15, G. U. Kidney abscess gravitating into pelvis discharging pus and urine.

Figure 24 illustrates an injected fistula resulting from an abscess in the kidney of a child 4 years old. It had discharged pus and urine for several months.

The injection was only made for diagnostic purposes. The case was under the care of another physician for a very serious heart trouble. The radiogram is presented to show how an abscess from the kidney may gravitate into the pelvis and not even be suspected. Pus discharge ceased but leakage of urine continued until patient died.

CASE 16, G. U. Six infected urinary sinuses, discharging urine and pus for ten years. Operation and bismuth injections. Closure eight years.

Mr. W. McCa, age 36, builder. When a boy of 17 he became entangled on the end of a power shaft and was spun around, pulling the penis, tearing the urethra and bruising the testicles severely. Urinary fistula remained at the scrotal perineal junction. Two years later surgeons in Aberdeen, Scotland, cauterized the fistulous tracts and they closed, but he had a very small urinary stream.

In 1892, twenty-three years ago, he began to have chills and fever. In the absence of other symptoms it was thought to be malaria and treated as such, but soon there appeared around the region of the old injury of the scrotum a formation of abscesses. These were either incised or opened spontaneously, some discharging pus, others pus mixed with urine. Later an abscess ruptured intrarectal. Practically no urine escaped from the urethra during urination but instead it escaped through all the sinuses including the one in the rectum. His general health gradually declined and his weight was reduced from 190 to 145 pounds. For the next thirteen years he was in this deplorable condition, when he came under my observation. I found the following condition. There were six sinuses in the scrotal and

perineal region. The adjacent skin was erythematous and tissues indurated, all sinuses discharging pus and three of them urine, including the one emptying into the rectum.

In March 1905 I inserted the right testicle and performed a plastic on the urethra. About one and a half inches of obliterated urethra was removed and the ends sutured together, thereby causing considerable shortening of the penis. This was followed two weeks later by a suprapubic cystostomy and a sound passed through the urethra from the bladder side and a definite passage for the urine effected. A permanent catheter with one end protruding through the abdominal incision and the other through the external urethra was left for about two weeks. It was noticed at this time that the urine contained a considerable amount of urinary salts which deposited on the catheter and it became very difficult to keep the catheter patent.

The patient made a good recovery and during the next two years would be effective in irrigating himself daily, this being sufficient to keep the urethra patent but some of the suppurative sinuses persisted the urinary were closed.

In 1910 following the formation of small abscesses and fistulous tract around the perineal and suprapubic region a second suprapubic cystostomy was performed with dilation of the urethra which was contracted and a permanent catheter inserted. About this time bismuth paste came into use and following the operation no injections with the paste were made. The fistulous tracts closed and I have remained so. Since that time the patient has had occasional attacks of fever and chills which are probably due to retention of some septic material. These attacks usually last about two days after which the patient feels perfectly well. The urinary stream at this time except being somewhat smaller than normal comes freely and clear through the urethra (see stethocentgenogram Fig. 25).

Present weight 230 pounds or a gain of 95 pounds in the past ten years. Urinary and pus sinuses closed for the past five years.

Case 17 G. U. Pyonephrosis, nephrectomy, suppurative twelve years. Closure after one injection of bismuth paste.

J. Lag. Irwin age 45. In 1898 had abscess of left kidney. It was incised and kept discharging pus feebly for four years. His health deteriorated weight 120 pounds. Radical operation for removal of the kidney performed by Dr. Carl Beck in 1901. This required incision from the twelfth rib to the middle line of the abdomen. A sinus in the abdominal wall persisted for another nine years.

In 1910 an injection with bismuth paste was made and the next day the discharge ceased and within one week the sinus closed and remained so up to date. With the exception of a ventral hernia the patient is perfectly well and has gained 35 pounds.

Case 18 G. U. Parimphritic abscess with fistula.

Mrs. LaC. was seen by Dr. Carl Beck at her home in Iron Mountain, Michigan. She has had several attacks of pain which were thought to be due to appendix or kidney infection. Finally a radiogram was taken and the diagnosis was that of stone in the kidney. During the operation for stone an abscess was found, which was opened and drainage instituted.

After months of persistent discharge she came to Chicago to me for treatment of the fistula. Injections of bismuth paste were made (Fig. 26) at intervals of one week and the fistula finally closed. There was a recurrence of the abscess a short time after which was then opened and the injections resumed with the result that the fistula closed again permanently.

Case 19 G. U. Renal and urinary fistula resulting from hip joint disease and spinal tuberculosis.

L. B. age 36 developed hip joint disease and spinal tuberculosis at age of nine. After a number of years of conservative treatment, abscesses formed around the hips and in the lumbar region. Several of these were incised and others opened spontaneously. At the age of 20 she had ten discharging sinuses. During the past ten years she underwent a number of surgical operations, none of which were of avail. At the age of 25 she joined the Christian Scientists and became a most devoted disciple of that cult receiving their constant treatment for eight years.

I saw her in 1909. She could not walk but could manage to get out of her very low bed about every half hour to urinate due to cystitis. The cystitis was the result of a perforation of a sinus into the bladder. One sinus perforated into the rectum and another about one inch from the anal opening. Here we have a combination of a hip and spinal tuberculosis causing a ureteral and a vesical fistula a most distressing combination.

The bismuth treatment had the effect of closing both the fecal and the urinary fistula but several of the suppurative sinuses continued to discharge.

The patient was soon able to be up and walk for blocks and resumed her worship at the nearest Christian Science church. In all sincerity she attributed her improvement to her faith in Christian Science. In order not to hurt my feelings she declared that I myself was a Christian Scientist but I was not aware of the fact.

The final result could not be traced.

Case 20 G. U. Suppurative urinary sinus following nephrectomy. Bismuth injections cleared up infection. Urinary discharge continued.

Mr. M. New Orleans age 30. Sickly for several years when in July 1912 he was operated upon in New Orleans for a pus kidney. Subsequent to this operation a urinary fistula persisted. A small stone irregular in shape passed through the fistula several months after operation.

In April 1913 he was examined by me. I found a discharge of pus and urine in considerable quantities

The injection of paste (see Fig. 27) shows a cavity two inches by one inch in diameter.

After this injection the pus discharge ceased but clear urine continued. After several more injections there was no diminution of the urinary discharge and I concluded that there was an obstruction in the ureter, either by stone or stricture and referred the case to his physician in New Orleans for nephrectomy.

CASE 21. G. U. Tuberculous hip joint disease with sixteen urinary fistulæ.

J. G., age 25 at age of seven suffered with pain in his right knee. A year later an abscess formed in region of the great trochanter and shortly after many abscesses formed around the whole pelvis all of which opened with the final result of twelve sinuses all discharging pus mixed with urine.

For the last seven years not a drop of urine was passed through the urethra. In 1906, Dr. S. of St. Louis curetted several of these sinuses. New abscesses formed when he was referred to me he had sixteen urinary sinuses, his right leg flexed and hip ankylosed. The whole pelvic region was in an acute eczematous condition due to the constant saturation of urine and pus.

I injected all the fistulæ at one time with a 33 per cent bismuth vaseline paste and two hours later the patient passed urine through the natural channel the first time in seven years. The urine contained a large percentage of pus and some of the paste.

The radiogram (Fig. 28) exhibits a veritable labyrinth of sinuses. The sinuses began to close rapidly and the eczema was markedly improved but a new trouble started. The patient developed a severe cystitis which required irrigation of his bladder. Within two weeks eight sinuses were closed the others markedly improved and one only discharged a few drops of urine. In this condition he returned to St. Louis. He died one year later

as reported to me by his physician, under the care of new doctors.

CONCLUSION

It is hoped that the study of these cases will illustrate to some degree the various types and points of technique in the proper application of the bismuth paste in genito urinary and facial fistulæ. It must be remembered that we are dealing with a class of cases in which the science of surgery, medicine and even quackery have had a chance and that out of this apparently hopeless group a large percentage has healed.

I have found that the failures which I have had and those which I have observed in the hands of others were mostly due to imperfect technique. As I gradually developed a technique my results became better and better and I am certain that if those who wish to employ this method will study the underlying principles in the technique as I have described them, equally good results will be obtained.

Most of the cases which I report here have had more than one operation before I saw them some as many as ten. If such results as I have shown are obtainable by a comparatively simple method like the one I have employed, such treatment ought to appeal to the patient more than the extensive surgical operations, especially since the surgeon cannot assure the patient that by operation a cure will be accomplished.

SHOCKLESS SURGERY WITH THE AID OF PARAVERTEBRAL ANÆSTHESIA AND SCOPOLAMINE AND NARCOPHINE¹

By GEHEIMRAT PROFESSOR DR BERNHARD KROENIG AND DR P W SIEGEL FREIBURG, GERMANY
From the University Frauenklinik

PERMIT me to present to you first the theoretical and then the practical technique of an anæsthesia which, I believe, fulfills in a large measure the demands which Crile has indicated in his notable animal experimentation. The results of Crile's experiments, as you know, are as follows:

Every psychological trauma such as fear, fright, etc. causes a morphological change in the brain cells, likewise every sensation of pain carried to the brain produces the same change in the brain-cells. This change occurs in the same degree when the animal is treated with inhalation narcotics as ether, chloroform, nitrous oxide, etc. If, on the contrary, the sensitive nerve-trunks are blocked at any point as is done in local anæsthesia, the sensation of pain does not reach the brain and no change of the brain-cells occurs. Prevention of this change is termed by Crile anoci-association.

To accomplish anoci-association it is necessary to eliminate first psychic trauma, second the pain of the operation, and third the post operative pain. The fulfillment of these three requirements would produce the ideal anæsthesia according to Crile's theory.

To eliminate the psychic trauma we have for several years preceded every operation by a twilight sleep. Until recently the scopolamine preparations have been of inconstant value. Lately, however, Straub has produced a stable and constant solution of scopolamine by the addition of 10 per cent of mannit. Morphine also has been replaced by Straub by a preparation of meconic acid morphine which bears the trade name of "narcophin." This preparation has the advantage

over the usual preparations of morphine in that it is fully as efficient in eliminating pain but shows the undesirable accessory reactions in a much smaller degree. It is, therefore, possible to give relatively much higher doses of narcophine than of morphine without danger.

With these two preparations twilight sleep is induced before every operation. This is done in the following manner:

Three to two and one-fourth hours before each operation 0.003 of "Scopolamin-haltbar," and 0.03 of narcophine is injected subcutaneously. One-fourth to one-half hour before anæsthetizing the patient, this dose is repeated, or, if the twilight sleep is already fairly deep, only one half of this dose is injected.

To increase the depth of twilight sleep it is necessary to avoid disturbing the patient by loud noises or light. Patients in twilight sleep are particularly susceptible to stimuli of light. To avoid this the ears of the patients are plugged with "antiphone", i.e., cotton plugs saturated with oil or wax, or hard or soft rubber plugs, and a cotton pad over the ears. The eyes are bandaged with a soft silk bandage. With these precautions we accomplish in the majority of cases a complete amnesia of the operation and preliminary preparations, or a complete indifference to the proceedings about them. Thus we accomplish the *first* of Crile's requirements, i.e., the elimination of the psychic trauma.

The *second* requirement is the blocking of the nerves. This might be done in laparotomies and gynecological operations by spinal anæsthesia, or by *conduction anæsthesia* outside of the dural space. I shall not further consider the advantages and disadvantages of spinal anæsthesia, for I consider it entirely surpassed by the conduction anæsthesia which we practice here. I consider the con-

¹ Read before the visiting members of the American Gynecological Club in Freiburg in Baden July 25, 1914 by Professor Kroenig. The material was gathered by Dr. P. W. Siegel in the Frauenklinik under the direct supervision of Professor Kroenig. The paper was translated from the German by Dr. Frank Konrad of Boston, Harvard Medical School, and assistant in the Frauenklinik of Freiburg. Because of the war the publication of this paper has been delayed. In the meantime the results of 420 new cases have been added.

duction anesthesia the most perfect form of local anesthesia.

This form of anesthesia gives a large field for operation outside of the area of infiltration and eliminates the undesirable anemia and infiltration of the field which results in the usual forms of local anesthesia. The conduction anesthesia however, will be ideal only when all operations especially laparotomies are possible under it.

As early as 1905 our clinic had considered the conduction anesthesia, and Sellheim former assistant here and now professor in Tuebingen, used it first and spoke of his results at the Kongress der Deutschen Gesellschaft fuer Gynaekologie in 1906. At that time he interrupted the intercostal nerves directly outside of the spinal column, and the ilio inguinal and iliohypogastric nerves on a level with the anterior superior iliac spine by the injection of cocaine. The attempts at that time gave only imperfect results and failed principally on account of the danger of the cocaine. Since this time however the chemical industries have worked with great success on the preparation of anesthetics with the same anesthetic but less toxic qualities than cocaine. So far novocaine has proved itself the safest.

When I returned from America where I had seen the convincing histological demonstrations of Crile, I again recalled these experiments. An added stimulus was the success of Braun in a new infiltration process in which the sacral nerves were blocked directly at their exit from the sacral foramina and termed by him 'parasacral anesthesia'. This in fact was merely a continuation of the experiments of Sellheim in which the intercostal nerves were blocked immediately at their exit through the intervertebral foramina and termed by him 'paravertebral anesthesia'.

Braun succeeded in carrying out all operations on the vagina and perineum successfully with this form of anesthesia. We continued a step farther in contending that since it was proved by the investigations of Kuntzstrom that the abdomen is innervated only by the intercostal nerves of the corresponding thoracic segments it would be necessary in

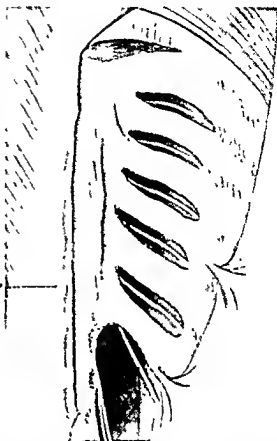


FIG. 1. Showing that entire space about intercostal nerves *ab* to be blocked was infiltrated. *a* Spinal process of the twelfth thoracic vertebra.

laparotomies to block only the intercostal and lumbar nerves innervating the field of operation.

Paravertebral anesthesia is quite simple in surgical laparotomies. Stomach, gall bladder and bowel operations are carried out with out difficulty because the innervation is relatively simple, the organs themselves are not sensitive. It is necessary to determine only the desired field of operation and to block the corresponding intercostal nerves. The conditions in gynecological laparotomies however present greater difficulties. The peritoneal coverings of the genital organs both in the pelvis as well as the broad and round ligaments are innervated by nerves from the lumbar and sacral plexuses. It is therefore necessary in gynecological laparotomies to

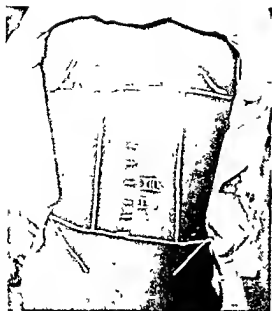


Fig. 2. Showing the first steps in blocking the nerves for paravertebral anesthesia.

use a combination of the parasacral and paravertebral anesthetics.

The paravertebral anesthesia serves for the anesthetization of the abdominal wall, the peritoneum and the relaxation of the abdominal wall, the parasacral anesthesia serves for the anesthetization of the pelvic peritoneum and ligaments.

For vaginal operations the parasacral anesthesia is usually sufficient. However since the pelvic ligaments are innervated in part by the ilio inguinal iliohypogastric and femorocutaneous laterals and since the pelvic peritoneum is pulled upon it becomes necessary to add a paravertebral anesthesia to accomplish perfect results. This however is necessary only when the operation includes the uterus and adnexa.

Up to date we have done (till September 15 1915) 536 gynecological and 114 obstetrical operations with conduction anesthesia only, 16 with paravertebral or parasacral or combined paravertebral and parasacral anesthesia. The cases include all the usual gynecological and obstetrical operations. In the tables here shown will be clearly seen the results which we have obtained. Table I



Fig. 3. Showing the needles in position for injection.

shows the various operations performed with this form of anesthesia.

TABLE I

Operations through incision over Poupart's ligament	
Inguinal herniotomy	3
Inguinal herniotomy	6
Alexander Adams operation	45
Tubal sterilizations	51
Total	105
Vaginal operations	
Whitehead operation for hemorrhoids	1
Vaginal hysterectomy	14
Submucous myoma	4
Cervix amputations	19
Colporrhaphies levator suture	102
Colpotomies	2
Total	142
Laparotomies and nephrectomies	
Gall bladder, bowel operations	23
Appendectomies (Kocher)	41
Ventral fixation (Doleris)	54
Adnexa operation	96
Total hysterectomy	31
Herniotomies (abdominal scar)	7
Removal of ovaries	37
Nephrectomies nephropexia	14
Bladder operations	3
Total	306

I wish to mention that the paravertebral anesthesia is particularly difficult in tube-



Fig. 4 Patient in lithotomy position ready for injections for paravertebral anesthesia

sterilization and in the Alexander Adams operations because the round ligament is innervated by the ilioinguinal, iliohypogastric and external spermatic nerves and by fibers from the sacral plexus as we have found by experience. The round ligament especially presented the greatest difficulties. Perfect results with it were obtained relatively late and the greater part of the added inhalation anesthetics in the early part of our work was necessary on account of the round ligament.

Table II shows 556 operations performed with a total duration of 509 hours and 46 minutes and a duration of peritoneal opening of 202 hours and 9 minutes. Of these operations 475 i.e. 85 per cent were done with out any added inhalation and in the remaining 81 operations a total of 80 ccm of ethyl chloride 63 ccm of chloroform and 736 ccm of ether were used. This would give an average of 0.36 ccm ethyl chloride 0.11



Fig. 5 Drawing from Fraun showing method of introducing needle in paravertebral anesthesia

ccm chloroform and 1.33 ether per operation in 556 gynecological operations with an average duration of 55 minutes per operation. Considering that in these estimations there was no choice of cases and that all earlier attempts were included we must consider these results as quite satisfactory. At present of course additional inhalation is used with much less frequency than was done three months ago. So far we have never experienced a total failure. The conditions of the case make it highly probable that at times a nerve may be skipped or insufficiently anesthetized. The worst that can happen is a partial success.

Table III shows 114 obstetrical operations of which 108 i.e. 95 per cent were done with out any additional inhalation, in the other six the use of a total of 29 ccm of ether and 5 ccm of ethyl chloride is so slight as to be of minor consideration.

Before I continue on the technique of paravertebral anesthesia let me say a few words regarding the drugs used. We use novocain, suprarenin 'A' in tablet form prepared by Farbwerke Hoechst in one half

TABLE II

Operation	Number	Duration in Minute	Opening of Peritoneum Minutes	Ethyl Chloride ccm	Chl. ccm	Ether ccm	With Inhalation in Addition	Without Inhalation in Addition
Craniotomy	101	190 minutes				0	11	0
Laparotomies and Splenectomies	107	1502 minutes	114.1	11	45	635	60	1
Vaginal periton	731	8102 minutes	625	11	9		20	13
Total	18	10156.0 hours 6 minutes	1234.6 20 hours 14.6 minutes	80	61	6	91	5



Fig. 6 Shows the position of the needles in the patient in parascral anæsthesization

per cent solution, and herein differ from the usual methods of conduction anæsthesia. By using this dilute solution we are enabled to inject large quantities of fluid before reaching the toxic dose, and since all the injections are perineural it is clear that the nerve is reached with greater certainty than with a

smaller quantity. The truth of this was demonstrated on the cadaver through the kindness of Professor Keibel, as is shown in Fig. 1. This shows that the entire space about the intercostal nerves to be blocked was infiltrated by our method of injection. There remained only the question whether a half per cent solution would be strong enough to anæsthetize the respective nerve-trunks, and our experience has proved that it is sufficient.

The principle of paravertebral anæsthesia consists in the blocking of the nerve immediately at its exit through the intervertebral foramen. To reach this point we use the following technique (Fig 2). The patient is placed on the table in the sitting posture with the head bent slightly forward. The iliac crests are located by touch; the spine of the third or fourth vertebra lies on a level with a line connecting these points. In a similar manner the angles of the scapula are located; the spine of the sixth or seventh vertebra lies about on a level with a line connecting these points. The intermediate spinous processes are then marked off, and a line parallel to the midline is drawn on both sides of the midline and four centimeters out. The needle is now introduced vertically down on the rib on a level with the spinous process, the rib next in number to the spinous process is thus touched.

If the lumbar nerves are to be blocked, the transverse processes are used as guides instead of the ribs. After locating the rib or

TABLE III

OPERATION	Number	Ethyl Chloride	Chloroform	Ether	With Inhalation	Without Inhalation
Post abortive curettage	22	5			2	21
Colporrhineorrhaphy	20					10
Forceps	25					24
Vaginal section	10			3	1	0
Abdominal section	27			27	2	25
Manual removal of placenta	2					2
Induction of premature labor	1					1
Cephalocranioclasty	3					3
Porro caesarean section	2					2
Total number of operations	124	5			6	108

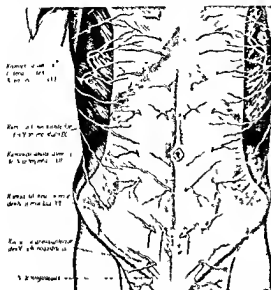


Fig 7 Showing the fibers of the sixth intercostal nerves running about on a level with the xiphoid process

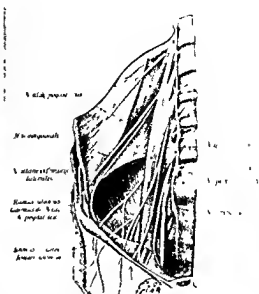


Fig 8 Showing genitofemoral nerve dividing into the external spermatic and lumbo-inguinal nerves

transverse process with the point of the needle, the needle is raised and inclined outward about ten to twenty degrees and pushed from two to three centimeters deeper, so as just to pass the lower border of the rib (Fig 3)

Here are seen two needles standing vertically over the ribs. The two upper needles are in position for injection; the angle is plainly visible. Now 15 ccm of a one-half per cent solution are injected into each intercostal space and in such a manner that at the beginning of the injection the needle lies deep, and is then gradually withdrawn so that at the end of the injection the point of the needle is on a level with the surface of the rib. This needle is now about on a level with the needle which is still on the rib. In other words, the needle point is on a level with the surface of the rib, and the whole area from the point of beginning the injection to the end of the injection is infiltrated with anesthetic fluid.

We use for the injections a needle six centimeters long for the thoracic nerves and eight centimeters long for the lumbar nerves as described by Braun.

To make the injections for the parasacral anæsthesia we place the patient in the lithotomy position with slightly raised pelvis, as

is seen in Fig 4. The technique is very much the same as that described by Braun, except that we use a one-half per cent solution. At first we locate the tip of the coccyx and mark



Fig 9 Shows the sacral nerves run together into the sacral and pudendal plexus

TABLE IV

Appendectomy	Paravertebral	Right dorsal Right lumbar 1 3 } Incl 7 20 ccm } = 220 ccm 1/2% = 1.1 grams
Appendectomy	Paravertebral	Right or left Dorsal Lumbar 4 12 } Incl 66 20 ccm } = 220 ccm 1/2% = 1.1 grams
Laparotomy for abdominal work	Paravertebral	Right or left Dorsal Lumbar 1 3 } Incl 66 25 ccm } = 330 ccm 1/2% = 1.65 grams
Cesarean section	Paravertebral	Right or left Dorsal Lumbar 9 22 } Incl 66 25 ccm } = 330 ccm 1/2% = 1.65 grams
Laparotomy for cholecystitis	Paravertebral	Right or left Dorsal Lumbar 4 12 } Incl 66 25 ccm } = 330 ccm 1/2% = 1.65 grams
Inguinal incision—lateral	Paravertebral	Right or left Dorsal Lumbar 4 12 } Incl 66 25 ccm } = 330 ccm 1/2% = 1.65 grams
Vaginal operation on uterus and annexes	Paravertebral	Right or left Lumbar Sacral (1 5) each side } Incl 66 20 ccm } = 320 ccm 1/2% = 1.6 grams
Prostate operation	Paravertebral	Right or left Sacral (1 5) each side } Incl 66 25 ccm } = 330 ccm 1/2% = 1.65 grams

two points, one on either side 1½ to 2 cm from the midpoint on a level with the tip of the coccyx.

Figure 5 is taken from Braun's textbook and shows the method of introducing the needle. The needle is introduced at the points marked off on a level with the tip of the coccyx and pushed forward till an obstruction is met. This usually happens at a depth of 7 to 8 centimeters and the needle point is then at the second sacral foramen. Now 25 ccm of a one-half per cent solution are injected after withdrawing the needle one half to one centimeter. Then 35 ccm are injected while the needle is gradually withdrawn to the skin, the third, fourth, and fifth sacral foramina are thus injected. The needle is then completely withdrawn and introduced again at a slightly greater angle with the sacral axis and parallel to it sagittally until an obstruction is met, now the point of the needle is at the first sacral foramen and about 10 to 12 ccm deep. After withdrawing the needle about 1 cm 20 ccm of a one-half per cent solution are injected.

Figure 6 shows the position of the needle in the patient. The needles shown are both 15 cm long. The first needle is at the second sacral foramen, the other, equally long but at a greater angle and about 3 cm deeper, is at

the first sacral foramen. The angle can be plainly seen. In practice we use only one needle. The two needles are here used to demonstrate the introduction of the needles. Finally the needle is entirely withdrawn, inclined well outward, and pushed between the tip of the coccyx and the rectum. Here 5 ccm are injected to block the anococcygeal nerves.

The whole success of conduction anesthesia depends on an exact knowledge of the innervation of the field of operation. As is well known the viscera themselves are not sensitive, likewise the sympathetic nerves are not sensitive to pain. The skin, fascia, and peritoneum are sensitive to pain, also pulling on the mesentery causes pain. In spite of the correct anatomical localization of the nerves our clinical knowledge of their distribution is rather primitive. Since we know from the demonstrations of Ramstroem as I have mentioned above, that in the innervation of the abdominal cavity the intercostal and lumbar nerves only need be considered, we are acquainted with the most important factors. The following illustrations show in a simple manner the innervation of the various fields.

Figure 7 shows the fibers of the sixth intercostal nerves running about on a level with

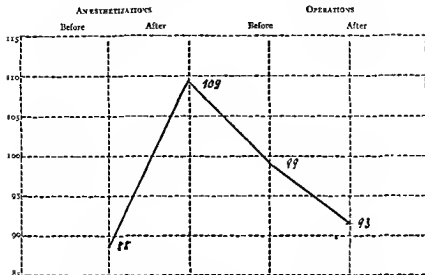


Fig 10. Pulse curve taken from 670 successive anesthetics

the xiphoid process. If we wish to perform an operation including the entire abdominal cavity we must block the nerves from the sixth intercostal nerves down. If, on the contrary, we wish to make a transverse incision and operate only on the genital organs, blocking of the nerves from the eighth intercostal space down is sufficient. It is seen also that the region of the groin is innervated by the iliohypogastric and ilioinguinal nerves.

Figure 8 shows the genitofemoral nerve which divides into the external spermatic and lumbo-inguinal nerves and plays an important part in the innervation of the inguinal region, and especially of the round ligament. The femorocutaneous also requires consideration.

These nerves are branches from the lumbar nerves, the femorocutaneous-lateralis springs from the third lumbar nerve, the genitofemoral from the second, and the ilioinguinal and iliohypogastric from the third. It is therefore necessary that in every gynecological operation the first and second and usually the third lumbar nerves be blocked.

Figure 9 shows that the sacral nerves all run together into the sacral and pudendal plexus. The entire vaginal and perineal regions, the broad and round ligaments and

in part the peritoneal coverings of the genital organs are innervated by them.

On the strength of anatomical demonstrations and clinical experience, we have prepared the following scheme (Table IV).

For an appendectomy it is necessary to block the nerve-trunks on the right side from the fifth dorsal to the third lumbar nerves inclusively, likewise for a nephrectomy. For general surgical operations such as gall-bladder and bowel operations the nerve-trunks from the fifth dorsal to the third lumbar nerves inclusively, for gynecological laparotomies blocking of the nerves of both sides from the eighth dorsal to the third lumbar nerves inclusively, and light anaesthesia of the sacral nerves is necessary.

The largest dose that we use here is 1.65 grams, that is 330 ccm. of a one half per cent solution, but lately we have given a dose of two grams without any alarming effects. The operation may be started from ten to fifteen minutes after beginning the injection.

Minor accessory reactions have been noted. In the first place I mention the behavior of the pulse. During the anesthesia it becomes smaller and increased in frequency, but this is of minor importance as it reaches its original frequency and strength at the end of the operation.

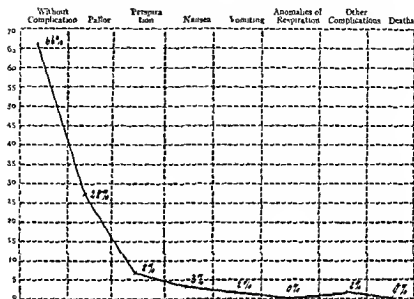


Fig. 11. Chart showing the complications in 670 successive anesthetics

Figure 10 shows the pulse curve of 670 cases. It shows a rapid rise to 109 beats per minute after anesthetization, a gradual fall to 99 at the beginning of the operation, and a further gradual fall to practically normal toward the end of the operation.

The respirations were controlled in 650 cases, and gave an average of nineteen per minute. The remaining accessory reactions were, as I have said, slight. I can best demonstrate this by the curve shown in Fig. 11.

Four hundred and fifty cases, i.e., 66 per cent of all cases showed no accessory reactions. No death resulting from the anesthesia was observed. The convalescence of the cases was satisfactory, and no complications due to the anesthesia were noted.

As a summary let me again show you a table of the figures obtained in our combined results (Table V).

Five hundred and eighty-three operations, i.e., 87 per cent of all cases, were done with any added inhalation. In the others the anesthesia was so slight as to be of almost negligible importance. There occurred during the anesthesia only minor and comparatively harmless complications. The after effects, too, were all transient, might have been due to operation itself. The convalescence was generally quite smooth.

With the paravertebral anesthesia we thus fulfilled the second of Crile's requirements; i.e., the elimination of the operative pain.

Our next consideration is the postoperative pain. This is made up of two components, namely, the pain in the wound and the pain due to the distention.

To relieve the pain in the wound we dusted into the incision after closure of it

TABLE V

Operations	Number	Ethyl Chloride	Chloroform	Ether	With Inhalation	Without Inhalation
Gynecological Operations	536	20	63	136	81	475
Obstetrical Operations	114	1	1	20	6	108
Total	670	21	64	156	87	583

layer a powder called *anæsthesin*. This is slowly dissolved and absorbed. We have begun these attempts coincidentally with others, and can so far report on about fifteen cases. The results, however, are not quite satisfactory. A reduction of the pain in the wound was accomplished, and in some cases a complete elimination of the pain, but in practically all cases there was an exudation and considerable hæmatoma. A coincident rise of temperature was not noted, and later the wounds all healed. The use of the drug

for this purpose might, therefore, be recommended with some hesitation.

The pains due to the distention can probably not be entirely avoided. The best that we can accomplish will be to shorten their duration. I shall not further mention the methods used, for no doubt you are familiar with them.

While we may now say that we have fulfilled the first two of Crile's requirements, there still remains a large field for the accomplishment of the third.

FINAL RESULTS IN TWELVE CASES OF COLECTOMY

By JOHN G. CLARK, M.D., F.A.C.S., PHILADELPHIA, PENNSYLVANIA

IN most of the literature bearing upon intestinal stasis one finds, as the basic motive for surgical intervention, the statement that the colon is a structure of more or less obsolete or perverted function. Startling assertions have been made as to the uselessness of the large intestine, and every conceivable method for restoring this so called drainage system has been suggested in order to obviate the evils of colonic toxæmias.

To Metchnikoff are attributed the theories concerning the noxious influence of the fermentation products of the large intestine, but it is to Lane that we are indebted for the initial step in the surgical treatment of these cases. In Lane's most recent monograph "The Operative Treatment of Intestinal Stasis," published in 1915, he quotes Metchnikoff's statement regarding his surgical efforts as follows "The results of his (Lane's) operations show (1) That life is possible without a great intestine (2) that in certain cases the conditions of life are improved." With this brief summary we are all, I believe, in accord. So far as my own observations go, I would lay particular stress upon the word "certain" as a limiting adjective, choosing to regard it of minimum rather than of maximum scope. Indeed from the experience of most investigators it is evident

that in only an occasional case are the conditions of life improved. If one views Lane's book in an attempt to find anything more than startling theoretic assertions borne out by a very limited marshaling of facts, one is doomed to disappointment. There are here no well digested series of case records from which one is able to draw conclusions as to the correctness of his assertions. Here and there an isolated history is inserted to sustain this or that theory. In a thesis so revolutionary in character as this one every case upon which the author has operated should be detailed fully. It is not the occasional brilliant result that counts in a work of this unusual character, but it is the analysis of all the cases that have come under the operator's care, with full histories and a painstaking follow up record system that permits the reader to bring his own judgment to bear on this very important subject. Until such records have been presented, the integrity of these hypotheses must rest on our personal experience and on that of other surgeons.

I cannot refrain from referring to some of the bizarre statements made by Lane in his most recent publication. In his description of the vicious influence of intestinal stasis, he portrays in vivid style, the decadence of an attractive woman who has become a prey

to this type of progressive toxæmia. He depicts the fair skin becoming pigmented, the splendid, rounded figure losing fat; the breasts becoming flabby and pendulous, and a sunny temperament being overcast by the deepening gloom of an ever-increasing mental and nervous depression. He follows the downward path of physical transformation and decline until "the whole contour of the woman alters conspicuously in the most objectionable manner." He then asserts that, with a radical change in the perverted drainage system, these objectionable conditions will disappear more or less completely. It is interesting to learn that red haired persons may survive even the fierce onslaught of intestinal stasis for Lane has discovered that the darker-haired subject loathes the sight of food and frequently abhors any sexual relationship whereas the red haired patient rarely manifests these symptoms even in the extreme conditions of intestinal stasis. In view of the rapid degeneracy of the race due to intestinal stasis such an observation should be seized upon with avidity by the various eugenic societies so that by converting the human race into a stock of sturdy red heads, it may be saved from a direful fate.

Lane may perhaps be hinting at this eugenic solution when he states that, through the enlargement of the uterus in pregnancy, the viscera are bolstered up, fat accumulates, and thus "a toxic thin miserable girl may be converted into a plump clean, happy one by pregnancy." Because of this splendid regeneracy he hazards the astounding suggestion that "it would seem almost justifiable in the unmarried girl in certain circumstances to resort to pregnancy rather than to operative interference."

A still more startling statement is made concerning the difference in the effects of the toxic influence upon vascular change in the two sexes. Although I believe we are all ready to admit that the toxic material must be the same in men as in women and that in both sexes the vascular systems and central nervous centers are similar yet in the face of this toxic and anatomic identity, Lane offers the following statement "Generally speaking, the soft heart and low blood-pres-

sure are common in the female subject, while the enlarged heart and high blood pressure are frequently observed in the male." Judged from a logical standpoint, could two statements be more diametrically opposed to each other?

In spite of the high regard we all have for Lane's splendid surgical skill, such divergent statements as these cannot be accepted. Beyond Metchnikoff's assertion that Lane has proved that life is possible without a great intestine, and that, in certain cases the conditions of life may be improved, I am sure that not many of us would dare to invade further what appears to be a fanciful realm. Lane alludes to Addami's critical lecture on this subject, which appeared in the *British Medical Journal* in 1914, and quotes the latter's criticism. Addami approaches the subject not from the viewpoint of the clinician, but from that of the pathologist, and propounds the query as to how far he may accompany Sir Arbuthnot and to what extent his doctrine may be accepted, for, he says "at first sight these seventeen symptoms and nine diseases indirectly induced seem to be in a horrible jumble."

So far as my own experience goes, I have taken up only that phase of this work which applies to that type of constipation so intense in degree as well nigh to constitute an obstruction. My series consists of twelve cases of colectomy. In following the subsequent course of these cases my enthusiasm has diminished rather than increased. In analyzing these cases I find that half may be regarded as satisfactory surgical results, the others leaving much to be desired. Several of the cases have done well for a time, only to be followed later by the symptoms of progressive constipation, and at least four cases are quite as dependent upon enemata and drastic purgatives as they were before the colon was removed, and one died several weeks after her discharge from the hospital from an intestinal obstruction.

An X ray study of three of these individuals shows that the ileum has undergone such marked dilatation as to deceive the roentgenologist into the belief that the colon had not really been removed.

If I had not read Lane's book, I should have regarded this sequel as due to defective operative technique, but he refers to this very danger as one of the evil sequels of the operation. In seeking an explanation for this unfortunate result, I agree with Lane that the formation of adhesions may be responsible in some instances, but I am convinced that in others this disability must be attributed to serious anatomic and physiologic defects created by the operation.

Great stress is being laid by some observers—particularly by Case—upon the necessity of having a competent ileocecal valve if proper intestinal function is to be maintained. Is it not probable that when we sever the ileum and implant it in the lower end of the sigmoid after the removal of the colon we make two serious errors first, in destroying the ileocecal cut off, and second, in forcing the small intestine to assume the vicarious function of the colon, thus gradually but irreparably causing a dilatation of the small bowel? Herein, I believe, lies the source of at least one cardinal error. I cannot attempt to discuss this subject in its relation to the "seventeen symptoms and nine diseases" for I have not had the temerity to venture into a field that appears so visionary.

As the result of my experience, however, I am convinced of one main fact, and that is, that as yet no technique has been evolved that meets an absolutely satisfactory surgical demand. Lane's own experience appears to confirm this view, for at first he made a side-to-side anastomosis and later abandoned it because the small blind sac of the terminal end of the iliac side of the anastomosis would dilate. This also occurred in two of my cases making a second operation for its correction necessary in one case. To obviate this evil Lane asserted that an end-to-side anastomosis would work successfully. He demonstrated his technique in this country two years ago but the method has apparently failed, for in his latest publication he discards this plan, and declares that an end-to-end anastomosis of the ileum with the rectum is necessary. Is it not probable that, with the shifting sands of clinical experience,

even this last plan of procedure will fall? In my opinion this is bound to occur in a considerable percentage of cases for *I do not believe that the small intestine will routinely take over the vicarious function of the colon*.

Speaking from my own experience, I would say that complete excision of the colon carries with it too high a mortality, and that the ultimate post-operative results are too unsatisfactory to justify so hazardous a procedure, except in the rarest instances. Mere operative mortality should not deter us from performing the operation, for in my own cases no primary surgical death has occurred, but the dangers of peritoneal adhesions, which have caused one death in our series four months later, and have necessitated a second operation in two others, and possibly the same sequel is forecasted in still others, constitutes a post-operative risk too real to be ignored. When in these cases the function of the small intestine becomes impaired, even though it may have acted most satisfactorily in the earlier post operative months, it is difficult or impossible to overcome this serious defect and further surgical efforts at relief are almost prohibitive.

I feel constrained, therefore, to abandon the total removal of the colon except in rare instances but I still consider that some of these otherwise hopeless cases may be relieved by following the plan adopted by Moynihan. This last observer sets forth in his usual brilliant style, the dangers of total colectomy, but speaks optimistically of the possibilities of better results following a partial excision of the large intestine. He discards ileosigmoidostomy, for he asserts that no method of anastomosis will prevent a backward flow into the upper limits of the colon. To obviate this difficulty, he believes, that nothing short of colectomy offers a substantial hope for cure. He limits his excision to the last part of the ileum, the cæcum, and the ascending and a portion of the transverse colon. If the descending colon and sigmoid are too long, he mobilizes the remaining colon so that all acute bends are corrected. By thus limiting the operation, that very important structure, the omentum, is not sacrificed, and the danger of the formation of adhesions is greatly minimized.

W. J. Mayo undoubtedly voices the opinion of every conservative surgeon when he says: "The number of persons whose condition would warrant the risk of the operation is comparatively small, and I cannot but deplore the widespread adoption, by the medical profession, of surgical measures for this and allied conditions while they are in the experimental stage, with little evidence to show that the supposed cures are permanent."

SUMMARY OF THE POST OPERATIVE RESULTS IN 12 CASES OF COLECTOMY

In the *Transactions of the Southern Surgical and Gynecological Society* for 1913, I have recorded in much fuller detail the results in eight cases of colectomy, and I now offer a brief abstract of these and of four additional cases, together with the reports as to their condition up to the present time. Some of the cases recorded two years ago as being satisfactory have remained so but one or two others that were considered as progressing favorably at that time have not maintained their improvement.

It is this tendency toward retrogression that has made us recede slightly, even from the conservative attitude which we assumed from the very beginning. If the removal of the colon in these extremely constipated individuals would lead to permanently good results it would be well worth the effort, even though the preliminary mortality might be considerable, otherwise, however the operation is not justifiable. In the light of my own experience I do not feel that total removal of the colon has given sufficiently good permanent results to justify its use except in rare instances, and then usually under the modified plan suggested by Friedrich and advocated by Moynihan.

If the ileum is anastomosed to the middle or outer third of the transverse colon the dangers of reverse peristalsis may possibly be obviated, and a competent and sufficiently capacious reservoir maintained to relieve the ileum from back pressure, with its consequent dilatation.

CASE 1. Gynecologic No. 3066. The patient was first seen October 5, 1909, when she gave the

following history. As long ago as she can remember she has suffered from such intense constipation that large doses of purgatives were required to give relief. For the last twenty years she has been subject to attacks of what she describes as "stomach trouble." During this time there have been distention and pain after eating. She is subject at times to vomiting spells, which are followed by comparatively long intervals of freedom from these attacks. She presents an emaciated appearance. The abdomen fluctuates between flatness and tympanitic distention. As this was a case of general ptosis, with excessive redundancy of the sigmoid, a lateral anastomosis was made from one limb of the redundant loop to the other, in the hope that this would overcome the constipation. The examination of the upper abdominal organs failed to reveal any visible pathological condition.

The patient made a satisfactory operative recovery, and during her stay in the hospital the bowels were kept regular and there were no gastric attacks. After returning to her home, however, the patient made no perceptible improvement.

She was readmitted to the hospital February 2, 1912, when she gave the following history. Since the operation, two years ago there were periods of a month during which she was moderately well, but for most of this time she was extremely constipated. The constipation was associated with attacks of severe vomiting. At times she is awakened out of a sound sleep by an attack of sharp pain. She vomits food taken two days previously. There is considerable general abdominal pain and when this radiates to the upper abdomen she begins to vomit. There is constant pain in the back and hip. She cannot work, even the slightest exertion being followed by exhaustion. There is also a history of gastric tetany.

The possibility of removal of the colon was discussed, and the patient gave ready consent to any operative measure that might afford her relief.

A second median incision was made. No adhesions were encountered. Perfect anastomosis had taken place between the limbs of the sigmoid flexure, and there was no evidence of any defect in the operation that might in any way explain the progressive symptoms. The colon was previously demonstrated was situated low in the pelvis and the hepatic flexure had disappeared entirely. The stomach was more markedly dilated than at the previous operation, and on examination the pylorus was found to be a large indurated mass, apparently of inflammatory origin. This had become evident since the previous operation for at that time there was no palpable or visible lesion of the duodenum or pylorus. As the mass was fixed, a simple posterior gastro-enterostomy was performed. The ileum was then detached from the cecum and attached to the sigmoid flexure by a lateral anastomosis. The colon from the cecum to the splenic flexure was quickly removed, this being done with comparative ease, as the entire

organ could readily be pulled out upon the surface of the abdomen

Convalescence was rapid and uneventful, and from the day of operation she had one or two stools daily without the use of drugs. Her appetite improved at once, the pain disappeared, and the results of the operation apparently were altogether satisfactory.

The patient continued to improve steadily, when suddenly, four months later, she was seized with obstructive symptoms for which an operation was performed in another hospital. An adhesive band that was found to cause the obstruction was released, but the patient failed to recover.

This case illustrates a danger that may arise after any abdominal operation, but is especially likely to occur after a colectomy when the omentum has been sacrificed. As regards the immediate results of the colectomy they were ideal and promised the most satisfactory outcome, but the patient became the victim of one of the grave dangers of this operation—the formation of intestinoventral or intestino-intestinal adhesions.

CASE 2 Gynecologic No. 3,404. The patient was admitted to the hospital August 25, 1910. She has always been subject to constipation, but from the time her first baby was born this symptom assumed an obstructive character. She has pains in both kidney regions, becomes nauseated and has cold, clammy sweats with paroxysmal pain in the lower abdomen. Beginning with simple laxatives she has progressively increased the strength of cathartics until now she takes Epsom salts every day. She has gone twelve days without a movement. Prior to her entrance into the hospital, the bowels did not move for five days, although she had taken large doses of purgatives.

An exploratory incision was made with a view of relieving the acute symptoms, and taking such necessary operative steps as the abdominal conditions demanded. The position of the colon bore out the X ray findings—the flexures, particularly the hepatic had disappeared and the largest part of the colon was situated in the pelvis. The colon could readily be drawn out through the incision, rendering its resection comparatively easy. The ileum was detached, and a lateral anastomosis effected between it and the lower end of the sigmoid flexure. The ascending and transverse portions of the colon were removed.

The patient withstood the operation well, but marked symptoms of shock speedily appeared from which she recovered slowly. Following the operation the patient had daily bowel evacuations—frequently as many as three or four a day.

After leaving the hospital the patient improved progressively. The bowels moved once or twice daily without the use of cathartics, thus making the

most radical change in the patient's life, for she states that she had not had a natural bowel movement for years.

May 12, 1912 The patient has made satisfactory progress since the last note. The bowels now move once daily, and the stools are formed. Thirst is present, but at most she does not drink more than eight glasses of water a day. She has slight attacks of pain in the epigastrium, and occasional nausea. She now weighs 110 pounds—the heaviest she has ever weighed. She attends to her household duties, and has the care of a semi-invalid daughter. The only distress she complains of is the bearing-down sensation that comes from a relaxed pelvic floor. **September, 1913** The patient reported for examination at the University Hospital, and stated that she is now quite well.

From an analysis of this case I would say that the following improvements were effected: (1) Absolute relief of constipation, (2) marked improvement in nutrition, (3) decided increase in efficiency—the patient, having formerly led a semi-invalid existence, is now able to do her own work.

There are no symptoms referable to the gastrointestinal tract except an occasional loss of appetite and slight distress in the epigastrium, which is not of sufficient severity to interfere with the performance of her duties. **May, 1915** Since the last note was made the patient has continued in excellent health. Speaking most conservatively, one may say that in this case a 75 per cent restoration of efficiency has been gained as the result of colectomy. This may, therefore, without undue optimism, be counted as a good result.

CASE 3 Gynecologic No. 3,689. The patient was admitted to the hospital on April 10, 1911. She is forty-six years of age, married, and has two children. She was operated upon in 1902 for extensive pelvic inflammatory disease, the tubes, uterus, and ovaries being removed. At the time of her discharge from the hospital she had pain over the upper part of the abdomen after eating. She returned one month later still complaining of the pain in the right side of the abdomen. Four years later pain appeared on taking food, and this was followed by nausea and vomiting. After four weeks medical treatment in the hospital she was apparently relieved. Two months later she had a serious fall from a considerable height. Since then she has had more or less continuous abdominal pain, headache, backache, nausea, vomiting, and general nervousness. She was admitted to the medical wards of the University Hospital three or four times for the treatment of gastric distress and obstructive constipation.

After several months of ineffectual medical treatment she was referred to the gynecologic ward. An incision was made midway between the symphysis and the umbilicus. The transverse colon was found to be adherent to the lower angle of the wound and the stomach was likewise anchored through this attachment of the transverse colon, and the ad-

hesions were freed. The patient was placed in the Trendelenburg position, and the hammock type of operation suggested by Coffey was performed. She made a satisfactory convalescence. A mild laxative was administered—just sufficient to move the bowels. A skiagram made subsequent to the operation showed the stomach to be in good position above the umbilicus. The patient was subsequently seen from time to time. She has made a most satisfactory improvement.

She was readmitted to the hospital April 10, 1911, five years after the last operation, after having had a heavy fall, a recurrence of the previous symptoms taking place. The patient was perfectly well after her operation, the appetite was good, food being retained, and she gained steadily in weight. No gastric symptoms appeared for one and one half years. Following a severe strain there was a gradual return of her former symptoms—loss of appetite, a heavy sensation in the epigastrium, a feeling of fullness and gaseous eructation after eating, vomiting, and acute general gastric pain. Symptoms of obstruction, more or less paroxysmal in character, were present. The bowels now move only on using drastic cathartics. The patient has lost rapidly in weight, and has fallen into a very wretched state. An X ray examination showed the colon again in the position of exaggerated ptosis.

At operation the colon was removed, and an anastomosis of the ileum into the sigmoid flexure made. The duodenum was now found to be greatly dilated, being at least twice its normal size, its walls were very thin and attenuated. Because of the more or less constant vomiting from which the patient has suffered previous to her entrance to the hospital a gastro-enterostomy was deemed advisable. The operation was followed by considerable shock, and for a few days the patient was in a critical condition. After this, however, she made a rapid convalescence, and showed the most satisfactory immediate improvement as the result of the operation. She began to take food at once, her appetite became normal and there was a rapid increase in weight. For fifteen months the patient remained in perfect health, when she developed a persistent diarrhoea that was for a time very obstinate but was finally controlled by medical treatment.

November 2, 1913. Diarrhoea ceased eight months ago. The bowels now move three or four times daily, usually after eating. The movements are now partially formed, and there has been no sign of constipation at any time. She complains of pain immediately after eating, beginning in the epigastrium and extending over the entire abdomen. There is a good deal of belching, and she occasionally has attacks of vomiting immediately after eating. There is no haematemesis. During the stage of diarrhoea she weighed 88 pounds, she now weighs 100 pounds. The appetite is poor.

September, 1915. The patient has remained about the same since the last note was made. The intestinal function continues to be satisfactory.

Although the patient's efficiency is greater than it was previous to her last operation, and although, unquestionably, she has improved very markedly since that time, she is still very neurotic. Certainly the constipation has been completely relieved, she has gained in weight, and her present condition is better than it has been for several years. Considering the temperamental equation in this patient, she is as well as she probably ever will be.

CASE 4. Gynecologic No. 3,938. Colored woman, aged 35. Admitted to the hospital November 2, 1911. The patient was operated upon before the Clinical Congress in 1911. She dates the onset of almost complete invalidism to a period thirteen years ago, when she had a miscarriage. At the time of her entrance to the University Hospital she was suffering from severe headaches. So far as she can remember she has always suffered from constipation, which grew worse after the birth of a child following several miscarriages, and has become practically obstructive. Although she does not vomit, she is constantly raising mucus. Occasionally she takes mustard water to relieve her. Regurgitation of food and eructation of gas follow every meal. No flatus ever escapes, and she is unable to have a natural defecation, but must resort to the most drastic purgatives in order to effect a bowel evacuation. The patient is a sparsely built woman, and has the appearance of being very ill. In view of the prolonged history of this case and the increasing obstructive character of the constipation an operation was considered advisable.

November 20, 1910. Celiotomy was performed. The colon had practically become a pelvic organ. It was dilated but otherwise appeared to be normal. There was no hepatic flexure. The transverse colon was of normal length passing obliquely upward from the caecum to the splenic flexure. After freeing the adhesions it was found that the stomach was pulled down and was somewhat dilated. The entire colon possessed a mesentery, and could be delivered through the incision. As the colon was found to be redundant dilated and markedly dislocated a colectomy was performed since it was impossible, in a distended abdomen, to replace it to even an approximately normal position with any hope of having it functionate normally. The ileum was connected with the lower portion of the sigmoid flexure by a lateral anastomosis.

The patient left the operating table with a pulse of 90, but within three hours symptoms of severe shock appeared. The pulse remained between 120 and 130 for two days after which it fell to the normal and the patient made a satisfactory recovery. On the third day the bowels moved twice spontaneously, and subsequently for a day or more, three or four times. The stools then increased in number until the twelfth day when she had only one or two movements. There was no undue thirst, her appetite improved rapidly, and on the fourteenth day after operation she took the ordinary ward diet without discomfort. All her neurosthenic symptoms disappeared.

February 11, 1912 Three months subsequent to operation the patient returned to the hospital with the statement that she felt perfectly well. There was no irritability of the bladder and the bowels moved daily. She can eat all food without distress, sleeps well, and does her entire housework. The pain in her back and the distress in the abdomen have disappeared entirely, and she is steadily gaining in weight. She has taken no laxative or purgative since she left the hospital.

October 20, 1913 The patient is doing her housework, and is apparently in the best of health. She states that her health is better than it has been for years. From her former weight of 115 pounds she has gained until she now weighs 136 pounds. She sleeps soundly and has a good appetite. She has two well formed movements daily without pain, and never takes a laxative. Says she is now perfectly well and happy which she never was before.

August 1915 The patient has not been seen since the last note was made but a neighbor, recently admitted to the hospital declares she is quite well.

Everything considered this may be counted as an ideal result.

CASE 5 Gynecologic No. 4,192 The patient was admitted to the hospital May 4, 1912. She is thirty-six years old, has been married seven years, and has one child, labor difficult. As far back as she can remember she has been constipated, requiring the use of cathartics frequently. About fifteen years ago she began to have severe occipital headaches, which forced her to give up her regular work while the attack lasted. At these times she noticed that the constipation was more stubborn, and that the headaches bore a distinct relationship to the condition of the bowels—that as constipation produced the headache an evacuation would relieve the pain. She has had indigestion for years, expressed by a fullness in the epigastrium and belching. During the past year the ingestion of solid food has caused pain in the epigastrium. This pain comes on immediately after meals, and is often severe enough to cause her to double up, it is usually relieved by hot and cold applications. She has had attacks of vomiting, the vomitus containing food remnants of the day before. She suffers greatly from sour stomach and belching. Cathartics, no matter how drastic, have little or no effect beyond producing pain in the left iliac region. Relief is obtained only from a large enema. As long as fourteen days have elapsed without a bowel movement. She is never troubled with diarrhea. She has a constant feeling of depression, and has lost eleven pounds in weight during the last month. Although her appetite is not impaired, she refrains from taking solid food because of the pain that follows its use. Aside from a frequent desire to urinate when standing no symptoms referable to the kidney or bladder are present.

May 7, 1912 Operation was decided on because of the exaggerated degree of coloptosis and the increasing degree of obstruction, loss of weight and marked

invalidism of this patient. A median incision was made. The colon was found to be practically a pelvic organ. The gall-bladder and stomach were normal, so far as any demonstrable lesion was concerned. The colon was of enormous size, being not only greatly increased in length, but in diameter as well. Its walls were markedly attenuated. There was no flexure in the hepatic region. The colon was excised, and a lateral anastomosis between the ileum and sigmoid was effected. The sigmoid flexure was redundant, and to prevent sagging and possible obstruction of the anastomotic junction the upper portion of the sigmoid at the point of excision was suspended from the parietal peritoneum and covered with a cuff of omentum. The operation was followed by a stormy convalescence for three days during which there were symptoms of peritonitis and from which she gradually recovered.

June 11, 1912 Patient discharged, apparently in good health. The bowels move easily and the stools are well formed. Occasionally a simple enema or a glycerin suppository is necessary. During her convalescence the occurrence of sharp, cramp-like pains gave rise to a fear of possible obstruction. On September 10, 1912, the patient reports from the country, where she has gone for the summer, as follows: Until the middle of August she says she gained steadily, eating well, and digesting food without difficulty. There is no strain on defecation. She has taken no laxative or purgative recently. Has occasional pain, but this is not severe—usually only an uncomfortable feeling. She is slightly nauseated at times, but never vomits. Although gaining steadily in strength, there has been no increase in weight. She still has headaches, but they are not so severe as formerly. Occasional attacks of irritability of the bladder occur.

December 10, 1912 Since the last report the patient has made no progress, and her symptoms have not improved sufficiently to permit this case to be regarded as a satisfactory result.

February 1, 1913 No further improvement has taken place, and the patient will return to the hospital for closer study. Eating causes serious distress, and she has intense tympanites. There are decided signs of obstruction, due, it is believed, to intestinal adhesions.

April 30, 1913 Since the last note was made the patient has become progressively worse. For a time she had severe diarrhea, but now the stools apparently collect in the lower bowel, and the abdomen becomes greatly distended. She has paroxysmal pains, which are relieved only by the evacuation of a large stool. Defecation is accompanied by great pain, and the patient has fallen into her old nervous state again. She has no appetite, and for the past two months has confined herself to a diet of buttermilk. The pain is situated on the left side, over the site of anastomosis.

May 2, 1913 A second operation was performed. The abdomen was opened along the line of the old incision. The anastomotic opening between the

ileum and the sigmoid was found to be patulous, easily admitting two fingers. A very interesting condition, however, had developed in the blind end of the ileum, beyond the point of anastomosis. This had become greatly distended, forming a pouch that contained at least six ounces of fluid. It had swung upward upon itself, and had become attached to the ileum just above the point of anastomosis, and a pathologic communication between this pouch and the ileum had formed. The operation consisted in releasing the adhesions between the pouch and the ileum and in closing the fistula in the ileum. The pouch was next resected close to the point of anastomosis, and completely obliterated this cloacal formation. There was no evidence of adhesions in any part of the abdominal cavity.

May 18, 1913. Following the operation the patient made a very satisfactory convalescence. The bowels are moving spontaneously, and she is free from any abdominal symptoms.

October 1, 1913. Since the operation the patient has done moderately well. She is extremely neurotic and complains of pain more or less over the entire body. On the whole, however, there has apparently been a very decided improvement over the condition preceding the last operation. Her bowels move once or twice daily without the use of drugs. She has no nausea or vomiting. Concerning her gastro intestinal state she says: "My bowels act real well. My appetite is good, but I still have considerable gas."

Summarizing the results obtained in this case one may say that the gastro intestinal condition has been improved. The constipation since the last operation has been relieved. The pouching of the blind end of the ileum at the point of anastomosis unquestionably argues in favor of an end to end rather than a lateral anastomosis. As to any marked change in the woman's neurotic condition, there has apparently been some improvement. In brief therefore, one may say that constipation has been relieved, the efficiency of the patient has been increased and the nervous is considerably better. Pathologic examination of the resected portion of the blind end of the ileum shows it to be the seat of a chronic enteritis.

CASE 6. Gynecology No. 4,216. The patient is a married woman aged thirty six years. She has been married six years and has two children, the youngest two years old. Labors very difficult—instrumental. As far back as she can remember she has had obstinate constipation, requiring the use of powerful cathartics as well as copious enemata to produce evacuation. At times she has taken large doses of castor oil without effect. From time to time attacks of diarrhea have occurred. Frequently during the last six months she has had attacks of unusually severe constipation, followed by diarrhea and persistent vomiting for many hours with agonizing occipital headaches. She suffers almost constantly with abdominal distention which is often so exaggerated that the

colonic outlines can easily be made out. At such times there is severe colicky pain along the course of the colon. Following the birth of her first child these symptoms all became greatly exaggerated. After the second child was born the obstructive symptoms became still more prominent. She is extremely nervous and irritable, and greatly depressed because she feels unable to give her children proper care. The occipital headaches are very severe, but are usually relieved by thorough evacuation of the bowels. For the last year she has lost weight and strength rapidly. Beyond slight heartburn and vomiting, there are no symptoms referable to the stomach. She states that the constipation was less marked during pregnancy.

May 6, 1912. Operation. A median incision was made. The colon, especially the cecum and the ascending and transverse portions, was greatly dilated. There was complete disappearance of the hepatic flexure, and although the splenic flexure was present, it was somewhat loosely attached. The cecum was redundant. The stomach, gall bladder, and rectum were normal. Colectomy, with lateral ileosigmoidal anastomosis was performed. Symptoms of post operative obstruction which followed were relieved by castor oil. From this time on the patient made a satisfactory convalescence, small glycerin enemata being given daily to clear the bowel. She was discharged June 7, 1912, the bowels moving easily after a small glycerin enema—in fact, they show a tendency to be a little loose. Pain has entirely disappeared, her appetite is good, and the patient has gained rapidly in strength. Her nervous condition is markedly improved.

After leaving the hospital the patient gained steadily in weight, this gain amounting to 22 pounds. She continued to suffer from headaches, but the attacks were less severe and more infrequent. The bowels moved daily without the use of purgatives or laxatives, and she felt better in many ways than she has for years.

September, 1915. About six months after operation the patient dropped back into her former condition of extreme constipation. It is now quite impossible for her to effect a movement without the use of a large enema. There is considerable paroxysmal pain at the site of the ileosigmoidostomy, indicating partial obstruction. The headaches are as severe as formerly, but the indigestion is somewhat better.

November 26, 1915. Patient writes, "I am no better—no worse—than when I last saw you. I struggle along from day to day, using both enemata and medicine to keep the bowels open. I have a great deal of rheumatism, and for the past few months have had almost constant headache accompanied with dizziness, and when I lie down the dizziness makes me feel as though I were fainting. Even the change of position while lying down seems to bring the same feeling."

It will be seen from this last communication that

the patient is no better and while perhaps her present condition is no worse, the operation can be said not to have brought any permanent benefit.

CASE 7 Gynecologic No 4,300 The patient is a married woman, aged thirty eight years. She has had no children, but one miscarriage five years ago. During the last two years she has had several convulsive attacks at the menstrual period. She is very apprehensive about these attacks and hopes the ovaries may be removed to relieve them. The patient has always been obstinately constipated, and in an effort to produce a satisfactory evacuation has taken castor oil, followed by "Pluto Water" and enemas. The constipation became worse after puberty. In June, 1910, she was operated upon for appendicitis, and for a time there was some improvement in the constipation, but during the last year the constipation has grown worse, but at no time has there been diarrhoea. For years she has passed large quantities of mucus, which occasionally has been blood tinged. During this time she has had constant pain in the left hypochondrium. This pain is at present continuous, but sharp exacerbations with sudden abdominal distention occur. She often has a "feeling of a ball at the site of the pain." This is not affected by the taking of food, but is brought on by stooping and by taking laxatives. It is relieved by a thorough evacuation. She has enormous bowel movements. Her physician states that after a thorough purgation an enema may bring away a large quantity of fecal matter. There is a sensation as of active peristaltic movements along the course of the transverse colon, stopping suddenly at the splenic flexure. When marked abdominal distention occurs, nausea and vomiting are likewise present. During the last three months three such attacks have occurred, no gastric symptoms whatever being present. There are no symptoms referable to the gall bladder.

August 12 1912 Operation. A median incision was made. The topography of the colon corresponds to the X ray negative. The splenic flexure is well fixed, the hepatic flexure is only partially fixed and the bowel assumes a more or less straight course from the cæcum to the splenic flexure. The cæcum is very large and quite movable and has a long mesentery. The ileum is not only greatly thickened but its caliber is markedly increased. The operation consisted in excising the colon to within about four inches of the splenic flexure, including the transverse colon, ascending colon, and six inches of the ileum. Lateral anastomosis between the ileum and the sigmoid flexure was effected. The uterus was found to be slightly enlarged, and the ovaries and tubes were normal. In spite of the patient's urgent request, the ovaries were not removed.

August 31, 1912 Since the operation the bowels have moved three times a day without the use of cathartics. Today the movements are fully formed for the first time. There is no undue thirst. The taking of food always precipitates a movement of

the bowels. The general condition and appetite are good.

September 30, 1912 The patient was discharged from the hospital. For the last week or ten days she has complained of pain under the left costal margin. This pain lasts only a few seconds, some tenderness always remaining. There is no elevation of temperature. The bowels move regularly three times a day, and the stools are partially formed. One dram of castor oil is sufficient to produce free evacuations. Her general condition is excellent.

November 2, 1912 Her physician states that she has had one attack of obstinate constipation, with persistent nausea and vomiting, similar to the attacks previous to operation, but that he believes her condition is improved.

February 15 1913 The bowels move easily after a small dose of paraffin. There is no further intestinal stasis. An X-ray picture shows the site of anastomosis to be patulous, and there is no damming-back of the bismuth or fecal matter in the descending colon—the portion left after the operation. The patient has had another convulsive attack at the menstrual period, which has greatly depressed her, and both she and her husband insist that a second operation for the removal of the ovaries be performed.

September 10, 1913 Since the last note was made the patient has had no trouble with the intestinal function. One or two movements occur daily. She still has pain under the left costal margin. Another menstrual epileptic seizure has occurred. At the urgent request of patient and husband an ovariectomy was done. The result of the colectomy was found to be perfect, there were no adhesions, and only a slight dilatation of the distal end of the anastomosed ileum, which was invaginated for fear of further dilatation taking place. The patient has been relieved of constipation.

November 15 1915 Since the last note was made the patient's physician reports that she has continued to suffer from pain in the upper portion of the abdomen. No convulsive attack has occurred for the last year. The function of the intestine is moderately good, although occasionally, as the result of an indiscretion in diet, she has attacks of constipation attended with nausea, vomiting, and severe headache, which are, however, relieved by catharsis. During this time she has tenderness over the area where the cæcum formerly was. On account of the gastric disturbance it is necessary for her to adopt a light diet. Summarizing, her physician considers her better than she was before the removal of the colon, but the patient is, nevertheless, far from well.

CASE 8 Gynecologic No 4,801 The patient, aged twenty eight years, was admitted to the hospital July 8, 1913. She has been married five years. His had one miscarriage in the third month. As far back as her memory goes she has always been obstinately constipated, the obstipation being much worse since her marriage. Since her present illness

began she has steadily lost weight, falling from 150 to 115 pounds. She suffers constantly from occipital headaches, sleep being disturbed continually by intestinal pains and tympanites. The appetite is capricious—some days, good, on others, bad. Following a meal the abdomen becomes markedly tympanitic—feels full and distended. Three operations have been performed in another hospital as follows: As a result of increasing discomfort and serious constipation an appendectomy was done three years ago, but gave no relief. A second operation was performed one year ago, but this consisted merely of an exploratory laparotomy. A few calcareous glands were found in the mesentery, and these were removed. Again there was no relief. On account of the obstinate constipation a lateral anastomosis between the sigmoid and ileum was made five months ago. For six weeks subsequent to this operation there was marked relief, but since that time all her old symptoms have returned in an exaggerated degree. Paroxysmal pain, attended with obstinate vomiting, is of almost daily occurrence. The bowel movements are liquid, and she suffers from severe tympanites. Because of the obstinate nausea and vomiting and the paroxysmal pain a fourth operation was deemed absolutely necessary.

Operation July 10, 1913. An incision was made in the median line and an anastomosis between ileum and sigmoid effected. The colon was found to be greatly distended. There were slight adhesions, none being of an obstructive character. The entire difficulty, therefore, seemed to be due to an obstructive fecal stasis of the colon. The ileum was ligated and occluded close to the point of anastomosis with the sigmoid, so that no pouch could possibly form. The remaining portion of the ileum up to the cæcum—about eight inches—was removed, along with the colon around to the splenic flexure. The patient made a very satisfactory recovery, the bowels moving daily during the time she was in the hospital. For a short time subsequent to the operation she continued to do well. The following note from her physician was received October 3, 1913: "Mrs. T. returned home in good shape, and continued to do well, with the exception of a little soreness in her abdomen for about ten days to two weeks. She then had a severe attack of colic. A week later she had a similar attack. Pain was intense—required one-half to three quarters grain of morphine to control it. Coincident with these attacks there was swelling in the left side of the abdomen, which was quite sore and painful on pressure. I took this to be an impaction of the sigmoid, and instructed the nurse to give several enemata. Considerable hard fecal matter was washed out, and this gave immediate relief. I may say, however, that, prior to this attack, she had daily liquid movements. She has had two or three attacks since, but they have not been so severe. I have instructed her to take an enema every day and wash the bowel out completely. I am not sure

whether this is the cause of her trouble, or whether she may have some little obstruction due to some adhesion, but the fact that she gets relief when the bowel is cleared out leads me to believe that the whole trouble is due to impaction of the blind end of the sigmoid."

Since the last note was made the patient returned with serious obstructive symptoms necessitating another operation. Extensive adhesions had formed between the loops of the small intestine. One area was tightly constricted, necessitating excision of a few inches. The descending colon was removed. The anastomosis between sigmoid and ileum was released, and placed low down in the pelvis. After this operation the patient gained rapidly, there being an increase of thirty five pounds in weight in six months. The general condition has greatly improved.

November, 1915. Subsequent to the last note the old symptoms recurred with increased severity. An X-ray examination shows the ileum to be so greatly dilated that it simulates the large intestine in caliber. The patient has again lost weight, and is in a very wretched state, with more and more threatening symptoms.

CASE 9. Gynecologic No. 5,171. Patient is a single woman, thirty seven years of age. Admitted to hospital March 25, 1914. The present complaint began four years ago, when she had what was said to be intestinal indigestion. For the succeeding two years, six or seven attacks occurred, with sharp, cramplike pain attended with nausea. Since then these attacks have become more and more frequent, and for the last six months the patient has been bedridden. Whenever she is on her feet an attack comes on, beginning with severe pain low down in the right side of the abdomen, accompanied by nausea. At such times it is extremely difficult to relieve the constipation, large doses of castor oil and other drastic purgatives being required. An enema of any quantity sets up intense paroxysmal pain. Up to two and one-half years ago constipation was of moderate degree, but since then it has grown progressively worse, and is now very stubborn. Purgatives in large quantities and frequently repeated must be taken to effect an evacuation. At times she has severe nausea, but no vomiting. The patient suffers greatly from headaches, which are relieved by a free movement of the bowels. She passes no mucus or blood. There has been a progressive loss of weight and strength during the past year. An X-ray examination showed intense colonic stasis with a large, dilated cæcum.

Operation. A long median incision was made. A few frail adhesions were found in the pelvis. The tubes and ovaries were normal. The cæcum was of enormous size and freely movable, with hypertrophy of the terminal portion of the ileum. There was no fixation of the hepatic flexure. The sigmoid was normal in caliber although somewhat redundant. The gall bladder and stomach were normal. The operation consisted of the excision of the terminal

ileum, ascending and half of the transverse colon. The omentum was not sacrificed. The stump of the transverse mesocolon was enveloped with the omentum, and a side to side anastomosis between the ileum and the lower end of the sigmoid effected.

Post-operative pneumonia developed, affecting the lower right lobe. There was severe pain in the abdomen, but no abdominal distention and but little nausea. The bowels moved easily through the tube. The patient continued to suffer greatly from the pneumonia, which gradually cleared up, but was followed by pleurisy and empyema. Aspiration of the pleural cavity was performed, followed by a small incision, with drainage and gradual relief. Two weeks later a mass formed in the right side, at the site of the mesentery of the ascending colon. The indurated area was opened under gas anesthesia. No pus was found. The temperature continued irregular for several days but this condition gradually subsided. Patient did not, however, recover sufficiently to leave the hospital for two and one half months. During this time the bowels moved with great regularity and without difficulty.

Subsequent to the patient's return home a small fistula developed at the site of the incision into the indurated area—a fecal fistula of small caliber, which remained open for a month and then closed spontaneously. Since then the patient has gradually gotten about. She has gained in weight, and in many respects is markedly improved.

October 1, 1915. For the past six months the patient has gained greatly in strength and in general health. She looks very much better, so far as physical appearance goes, but reports that the constipation is gradually increasing, requiring the use of mild laxatives. Paraffin oil is usually sufficient to cause an evacuation, but it is occasionally necessary for her to resort to an enema in order to clear the colon. Her physical condition has improved sufficiently to permit her to return to work.

According to her own estimate, she is very markedly improved, and has been relieved of all her old intestinal pains and to a large extent of her headaches.

The results in this case show what has been noted in others of the series, namely, a temporary relief of constipation with a gradual return of symptoms.

CASE 10. Gynecologic No. 4,999. The patient is a single woman, aged twenty-seven. She has suffered from constipation as long as she can remember, but this has become markedly increased since the insertion of a Wylie drain. Removal of the appendix, and suspension of the uterus were done two years ago in her home city. Since then drugs have proved almost ineffectual, and one or two enemata are required daily. With the onset of the severe constipation there have been frequent urination and constant irritability of the bladder. Relief usually following thorough evacuation of the bowel by an

enema. There is more or less constant pain in the lumbar regions, described as a heaviness or bearing-down sensation. The patient suffers of late from intense headaches, which almost totally incapacitate her. The constipation has now reached the stage where it is obstructive in character, and her physician feels that immediate operation must be performed to relieve her.

The X-ray examination revealed great dilatation of the large bowel, particularly in the cecal region. The cause assigned by the roentgenologist for this condition was the presence of adhesions of the sigmoid in the pelvis.

During several days' stay in the hospital, under observation, every effort was made to correct the obstructive constipation by regulated diet and the use of purgatives, but these were of no avail. As a rule the bowels could be evacuated only by placing the patient in the elevated hip posture, and using a voluminous enema.

Operation, December 8, 1913. A median incision was made. Examination of the pelvic organs, gall-bladder, and stomach showed them to be normal. The colon was greatly dilated and thin walled, and there was great redundancy of the sigmoid flexure, but no definite point of obstruction. Several small, veil like adhesions around the sigmoid were broken up. On account of the patient's frail condition, and as the caecum lay in direct contact with the sigmoid in the pelvis, an anastomosis was made between these two portions of the large bowel. In order to obstruct the current of the intestinal flow the ascending colon at the hepatic flexure was doubly ligated and separated, with infolding of the two stumps. A rectal tube was passed into the sigmoid and through the anastomosis into the caecum. For several hours immediately following the operation there was severe shock. Under appropriate treatment this subsided, although the pulse remained rapid for some days. The constipation and distention appeared to be decidedly better for a few days but reappeared and were as bad or even worse than before the operation. It was impossible to secure a thorough evacuation of the bowels. A proctoscopic examination showed that the opening between the sigmoid and the caecum was patulous. After several days' further observation it was found that this form of anastomosis was absolutely valueless, as the fecal current failed to flow satisfactorily from the caecum into the sigmoid.

As the patient was growing progressively worse, it was found imperative to perform a second operation, at which the ileum was anastomosed into the sigmoid and the ascending colon and a portion of the transverse colon, at the point where it had previously been occluded were removed.

Subsequent to this the patient made a very satisfactory recovery, and the bowels immediately assumed their normal function, a satisfactory evacuation following the use of a small amount of liquid paraffin. There was very little abdominal dis-

tention and no pain was present. The appetite immediately became better, and the patient gained rapidly in weight.

March 27, 1914. Since the patient left the hospital she writes that she is troubled with gaseous distention, but that no flatus escapes. She is gaining in weight, and is feeling better than she has for two years. Has had one or two attacks of headache, but these have been of much milder degree. Altogether, she is markedly improved and feels better each day. A small amount of orange-juice and liquid paraffin are sufficient to cause a movement daily. Subsequent to this the patient returned to her work as a bookkeeper.

November 1915. Since the last note the patient has drifted back into her old state and now the constipation is as bad as ever. She is able to work only half of the day, the remainder being given over to various manoeuvres to secure a fecal evacuation.

The first operation (anastomosis between the caecum and sigmoid), even though the ascending colon was blocked, proved absolutely futile. The intestines could not be made to move through this reverse channel. The complete failure in this case would prohibit any attempt at this type of operation again. In my opinion such an operation is inadvisable for the fecal current will not follow this course if as in this case, the intestine is blocked or it is left ptotulous above, for the ascending colon tends to drive the fecal matter upward and not downward. The case shows the tendency observed in others of our series, viz. a period of a few months of improvement followed by a recurrence of the intense constipation.

CASE 11. Gynecologic No. 5152. The patient was a married woman, twenty six years of age. She was admitted to the hospital March 16, 1914. She has never had any serious illness. After the birth of her baby, three and one half years ago she began to have rectal pain with constipation. From this time on she had to use drastic purgatives. During the summer months her condition improved, but as soon as cold weather came on she became severely constipated passing large quantities of mucus. She may go as long as ten days passing nothing but mucus and then as the result of purgatives, a large evacuation will occur. Mucus is passed more or less constantly, and large quantities of gas are eructated. There is tenderness and soreness over the colonic outlines. She has been in the hands of an excellent physician who placed her on a careful diet and prescribed irrigations of the colon, but notwithstanding this treatment her condition has steadily grown worse. She has lost at least twenty pounds in weight.

An X ray examination shows dilatation of the ascending colon to the middle of the transverse portion. From this point the caliber of the intestine appears to be normal.

Operation was performed three days after admission to the hospital March 19, 1914. A partial

colectomy was done. The caecum was a large, mobile sac, and along with the ascending colon was greatly dilated. The terminal portion of the ileum was greatly distended and hypertrophied. The transverse colon was dilated to a point at about its middle, where it decreased to the normal size. Back of this point the intestinal wall was thin and parchment like in appearance. The sigmoid was normal in length and in position. The ascending and transverse colon, to the normal portion of the bowel, was removed, and the ileum was connected with the lower end of the sigmoid by a side-to-side anastomosis. The patient's convalescence was uneventful. Constipation immediately disappeared, and improvement set in at once.

September 21, 1914. The patient has gained twelve pounds in weight, and her health has been splendid until two weeks ago. The bowels have been regular, requiring no laxative, and moving twice daily. There is no pain. Three days ago she began to have diarrhea. Under starch-water and bismuth injections the condition improved and the bowels returned to the normal.

November 9, 1915. Since the last note was made, the patient has been in fine health. The bowels have moved regularly. The appetite is good. She has gained several pounds over her highest normal weight preceding the operation, and in every way the operation appears to have been highly successful. There has been a slight recurrence of diarrhea similar in character to that previously noted. The same plan of treatment was again advised.

CASE 12. The patient a single woman, aged twenty one years, was seen in consultation with a surgical colleague in a neighboring city on April 25, 1914. Her history was as follows:

Two years previously the patient had been operated upon for chronic appendicitis. The attack began with pain in the umbilical region, colicky in character and located in the right iliac fossa. It was attended with nausea but no vomiting. She was operated upon the following day, and an intussusception of the ascending colon and ileum was found. These segments were invaginated four inches into the ascending colon. There was a rent in the omentum through which the ileum protruded. The patient made an uneventful recovery. A second attack occurred March 12, 1914. It began with diffuse colicky pain in the abdomen, followed by a chill, nausea and vomiting. The temperature rose to 101° F. and the pulse was 116. She was operated upon on March 24, 1914, when an acute obstruction of the large intestine was found, due to adhesions along the ascending and transverse colons. The adhesions were released. Convalescence was uneventful until April 13, when her temperature rose to 102°. Pain again appeared in the abdomen with vomiting and distention, and the bowels were obstinately constipated. This condition continued until the 17th of the month, when she was again operated on for obstruction of the bowel. Again an intussusception of the ileum had

occurred into the head of the cæcum. The adhesions were released as before, and convalescence was uninterrupted until April 25, when the symptoms recurred. The patient was operated upon again and a lateral anastomosis between the ileum and the transverse colon was made. The condition of the patient did not improve. Convalescence was disturbed, and three days later the pain returned in all of its severity, and the bowels became obstinately constipated. Nausea, vomiting, and great distention occurred. A partial evacuation took place, but with only temporary relief of the symptoms.

In consultation with my surgical colleague, we decided that it would be useless to consider any other operation than removal of the colon and anastomosis of the ileum with the transverse colon beyond the point of adhesions. The operation was performed under nitrous oxide anesthesia. Convalescence was good, but she continued to have a slight elevation of temperature until early in May.

Subsequent to this her condition rapidly improved and from the time of operation up to the present, November 16, 1915, the bowels have moved with marked regularity. Occasionally a slight attack of diarrhoea occurs. Her digestion is normal. She has resumed her work, and feels perfectly well.

The history of this case is included in this series not as an example of constipation, but as one of definite obstruction, in which the anastomosis of the ileum into the transverse colon was performed with the removal of the ascending and middle portion of the colon followed by a very satisfactory result so far as intestinal evacuation is concerned.

SUMMARY

1. In only 6 of the 12 cases operated on may one consider the result as entirely satisfactory.

2. In all cases there has been great improvement in the constipation for a time, to be followed at variable intervals in four by a gradual recurrence of the constipation. In some cases this has not been so severe as formerly, where as in others it is quite as intense. X-ray examinations in three cases showed in two decided dilatation of the ileum to a size closely resembling that of the colon.

3. In none of these cases has there been diarrhoea of long standing, and none that was not controlled by simple medicinal measures.

4. In none of the cases has there been undue thirst.

5. In six cases there has been marked improvement in nutrition. In the remainder there was no visible effects so far as physical improvement is concerned.

As a final summary of these cases, we feel that total removal of the colon is justifiable only in severe cases of obstructive constipation. From our experience in the foregoing cases we are of the opinion that a less radical procedure must be employed, and incline to the limitation of the colectomy to the ascending and the middle of the transverse colon, with a lateral anastomosis of the ileum into the transverse colon. In this way the omentum is preserved, and there is far less traumatism to the mesentery, with its very important sympathetic nervous system. From our experience in one case alluded to in this series, and in two or three others in our case records, we are convinced that any form of anastomosis between different segments of the colon or between the cæcum and sigmoid flexure, with the expectation of diverting the fecal current into this new channel, will almost invariably be doomed to failure.

Finally, we believe that the one valuable point gained in the study of our series of cases of colectomy is that the ileum will not uniformly assume the vicarious function of the colon, and that the backward pressure from the colon through the anastomotic opening, when it is low down, in a definite proportion of cases causes dilatation and permanent impairment of the ileum.

If a technique can be devised that will prevent the reflux into the ileum it will serve a splendid purpose in obviating one of the objections to an extensive colectomy. In severe cases of obstructive constipation I believe our cases demonstrate that it may be a very efficacious operation if carefully restricted and may be added to our surgical therapeutic list. The immediate danger of the operation and the serious sequelæ that may follow weeks or months later make it, however, too hazardous to extend it into the wider fields so ardently advocated by Lane and his enthusiastic followers. It may be efficacious but it possesses no miraculous function.

VARIED TOPICS CONCERNING THE SURGERY OF INFANTS AND SMALL CHILDREN¹

By COLEMAN G. BUFORD, M.D., F.A.C.S., CHICAGO

THE scarcity of infants and young children as patients in any one general surgical service impressed me many years ago. It is generally assumed that the surgical service in a children's hospital is limited in the amount and variety of work. This is not necessarily true. Children's hospitals are rapidly being brought to high standards of efficiency which will soon make them important centers of medical education and research. I am convinced that no more fertile field exists for research work and human benefaction than that of general pediatric surgery. My greatest inspiration and aid has come through my visits to some of you, when I have learned how you viewed and what you were doing for afflictions in which I was especially interested. I am therefore prompted to review briefly some of my experiences and views concerning a few of the more common afflictions which have come into my service in the Children's Memorial Hospital.

Young children should not be brought into hospitals for diagnostic work if it can be thoroughly done at the office, home, or in the Out-Patients Department. This especially applies to nursing babies; inanitions and contagions are too often the penalty. A baby when upon a dressing or operating table should always have a hand of an attendant resting upon it. I have seen two babies fall to the floor while adults stood against the table on either side amused at the giving of this precaution.

Both minor and major surgical work in early infancy should be deferred if this can be safely done, recovery rates from both increase in the first year with each month of life. The terrible mortality from major surgical work done in early infancy has never been properly impressed upon the profession. This high mortality is due—

1 To lack of equipment and preparedness to do infant surgery

2 To hæmorrhage, which babies do not withstand. Our speed in operating and our instruments for stopping hæmorrhage are the same as those for adults. In infants we must regard bleeding points which in adult surgery we would pay no attention to. About 8 per cent of the adult bodily weight is blood, while in the newborn it is about 5 per cent. In adults (1) when 5 of this 8 per cent is lost the patient dies. Should a baby lose the same percentage it would be totally exsanguinated. The relative amount of blood lost by babies during operations is usually underestimated. They go to their beds and may deceive one by the quietness of their slumber and their rosy appearance. Continued watching will too often show good color of the skin which frequently alternates with extreme pallor about the lips and nose and is evidence of grave danger. When such pallors are seen the surgeons must give serious consideration to the immediate need of blood and do direct or indirect transfusion. Hypodermoclysis and transfusion with normal salt solution do not often satisfy the demand in young children and are usually given in excessive amounts, causing hydræmia and greatly diminishing coagulability. I consider both a waste of time and harmful to children who have developed acquired hæmophilia from continued oozing from small wounds, which is a frequent occurrence.

Most of the transfusion appliances are too large for introduction into infant vessels. If they must be used in emergency it is best to select the external jugular, if this is found too small, an attempt may be made to use the internal jugular or the axillary vein. Large glass aspirating syringes may be used as substitutes for the more complicated transfusion appliances. A 20 ccm. syringe containing 2 ccm. of 10 per cent sodium citrate may be filled with the blood of the donor and easily injected into the veins of children. Dr. Bernheim (2) lately devised a syringe

which aspirates blood directly from the donor and with pressure on the piston injects it immediately into the recipient. My colleague, Dr. Henry Helmholtz (3), has recently suggested the use of the longitudinal sinus for infant transfusion when the anterior fontanelle is open.

3 Shock is not the important factor in infant surgery as supposed. That which is usually termed shock is often the result of hemorrhage.

4 Inanition which frequently precedes surgical needs or develops in the hospital is often uncontrollable. An expert in infant feeding should be in attendance upon every one of such patients.

5 Unexpected contagion will always be a complication in infant surgery.

6 Wound infection is far more damaging to infants and young children than to the average patient in later life. Infants are not especially susceptible to wound infections but because of the smallness of their bodies dressings applied as for adults do not remain in place and thus expose the wound to infection. The close proximity of all abdominal and thigh wounds to the genitals render them liable to be soiled with urine or feces. Special consideration should be given to the need for small sized and securely fixed dressings in these regions.

7 The damaging effects of volatile anesthetics. The harmful effect of chloroform on young animals under certain conditions is well understood (4) and I am sure that ether occasionally causes yet unexplained protoplasmal damage to some children after anesthesia. Such children die without exhibition of clinical findings to account for their decline. Nitrous oxide gas is too dangerous for routine use among young children.

8 The high mortality is further increased by the serious nature of the afflictions, both congenital and acquired, requiring major surgery in early life.

9 I might add that young children seem to develop erysipelas after operation far more frequently than in the same number of adults. It usually puts in its appearance in some locality far removed from the wound, strange

to say it does not seem especially destructive to life.

Infants and small children remain more quiet and are far more amenable to reason and good care than is supposed.

Restraint after abdominal operations is rarely required. I usually let these patients roll about with freedom. Their illness invites quiet and dorsal rest. Later the habit of being quiet is established. When quietude is necessary they may be restrained on a Bradford frame. When dressings are disturbed by the child the use of the arms may be limited by applying long cardboard cuffs at the elbow or the use of mits upon the hands.

In clean securely closed abdominal wounds children are often allowed to sit up to answer to the calls of Nature. All wound dressings should be small and when possible sealed, with a view to avoiding soiling (7). In abdominal wounds I am now using minute, thin gauze coverings, which are held in place by wide zinc oxide adhesive bands passing around the body. The adhesive extends well above and below the wound and is applied with sufficient tension to remove any pull upon sutures in case of crying or abdominal distention. The children wear stockings and shirts or gowns which are fixed well above the wound. Diapers if used are dropped low in front to expose the genitals. In low abdominal incisions the urine is caught in receptacles in infant girls or tubed away in cases of boys. The bed coverings should not rest upon ligatured children for fear of their becoming wet or soiled, thus conveying infection to their dressings. The covers are elevated and fixed upon a cradle (7). Little children are kept in high-railed cribs walled in and partly covered by sheets and in cold weather heated by hot water bags. These beds were originally designed by us for the open air treatment of burns (7).

In the after care of all infants too much cannot be said about the value of intelligent feeding by competent pediatricians.

Preparations of the field of operation should be proportionately much larger than in adults. All preparations of the field should be made before the operation begins in order to diminish the time of anesthesia.

Laparotomy sheets should be small to avoid unnecessary wrinkling and folding back over the small field and should contain small slits. All sterile coverings must be firmly fixed to the field because they easily slide off these little bodies, exposing unprepared areas. The use of laparotomy sponges should be avoided whenever possible. Those used must be in proportion to the size of child. Long, narrow sponges are altogether most satisfactory in pediatric surgery. I use three widths — two three, and four inch — and eight to twelve inches in length.

The greatest assets in operations upon children are a stationary anesthetist with modern appliances, a stationary table nurse, and an interested assistant, each of whom contributes to rapid work, short operations and consequent safety.

The most frequent call for operations on infants in a children's hospital is for circumcision. If the lay demand were answered our work would be endless. There is a natural respect for this operation when connected with religious rites, otherwise, I feel that it is the most abused operation in surgery and one most poorly performed. Repair is not always a matter of a few days and the wound is not always free from infection, swelling, and pain. I believe that much of this is due to the use of catgut and to failure to engage in the sutures all of the tissue planes. I favor transection before the prepuce is removed. There are objections to every dressing in use. I have had the most satisfactory results when the wound was left entirely exposed but not allowed to come in contact with clothing or bedding. Sealed dressings invite the development of anaerobes causing severe erosions of the glans which threaten destruction. When I first encountered this all methods of treatment were more or less of a failure until I read Dr. Corbus' paper on erosive balanitis. Since then I have used dilutions of hydrogen peroxide for wet dressings which put a stop to the destruction far more promptly than anything I have employed. Caustics and strong antiseptics when applied to the eroded areas are harmful.

Most of the babies coming to us for circumcisions receive dilatation of the pri-

puceal ring and forcible retraction. Tight rings relax in time and when relaxed, if the mothers make diligent efforts to keep the foreskins retracted, they apparently shorten and in time remain retracted. The foreskin of most babies is long enough to be an excuse for an operation. I am usually guided by the following indications: Fissures and eczemas about the prepuce, other inflammations, rigid prepuceal rings, parental demands, and possible connection between the long prepuce and habits and neuroses.

Patients with hypospadias showing openings at the phrenum should rarely be operated upon. Many of these are harmed rather than benefited by operation. Unless there is some special reason for it, operation on the more deforming types of hypospadias and epispadias should be deferred until the organ is larger and easier to work with. Prepuceal hoods occurring in hypospadias should rarely be operated upon in early life because they may be of considerable value if plastic work is undertaken later.

Exstrophy of the bladder has not presented itself in my service. Among the cases which have come to my attention through my friends and associates, I recall no instance in which there was benefit of any consequence.

Stone in the bladder is not at all uncommon in early life. Since some of these do not cast shadows upon X-ray plates it is very desirable in suspected cases to examine the interior of the bladder both with sounds and the cystoscope. Cystoscopes for young children are now available. Stone crushing instruments should be used when possible instead of suprapubic or perineal sections.

Next to circumcisions relief from inguinal hernia is most frequently sought. Unless there is some special reason for operating, an endeavor is made to educate the parents to the use of the truss for all young children. About 90 per cent of these coming to us before the age of four years, upon whom we use truss treatment, recover in less than two years. The younger the child and the smaller the hernia the greater is the certainty of a cure. A large percentage of the very young children show no return of their hernia after three to six months. Trusses are worn day and night

and in the bath, they are of hard rubber with no perineal strap. The truss must be thoroughly washed and dried each day. Unilateral inguinal hernia is treated routinely with the cross-body truss. If it fails to prevent protrusion the pad is turned upside down or one of a different size or thickness is applied. If these fail the French truss usually proves serviceable. Bilateral inguinal hernias are treated by use of the Hood's truss and in babies having a pelvic circumference less than fourteen inches by a modification of this made for me by Hastings and McIntosh Philadelphia. If the circumference of the child's pelvis is less than 12 inches it is not often easy to fit a truss.

I try to follow pretty closely the following indications for operation for inguinal hernia in young children:

- 1 Strangulation and incarceration
- 2 Hernia not retained by properly fitting trusses
- 3 Parental neglect in use of a truss or parents who refuse to allow truss treatment
- 4 Failure to cure after a child has worn a truss two to four years

I much prefer to postpone operation for inguinal hernia until the child is of an intelligent age and will help to keep his wound free from excrement contamination. When operated upon, difficulties should be anticipated. Yourself and interne should look at the dressings upon each visit. Our after care is about the same as that outlined for laparotomy. Larger children may wear one piece pajamas out of which a large opening is cut exposing the genitals and dressing (7).

Umbilical hernias are numerous in our out patient work. I think those recovering by use of commercial trusses do so in spite of them rather than because of them. I have never seen one of these which could be kept in place. I use wooden button molds (hemispheres) about $\frac{3}{4}$ inch to $1\frac{1}{4}$ inches in diameter covered with zinc oxide adhesive ironed down with the fingers to smoothness. These are retained in place by wide strips of zinc oxide adhesive which encircle the body 14 times. The adhesive on one side of the body is lined so that the skin will be in good condition there when the appliance is next

changed. It is changed about once in two weeks. The skin is cleaned with benzine, alcohol, and water in succession. The adhesive follows the contour of the body rather than encircle it, thus both edges of the binder are of equal tension.

The very small umbilical openings are usually surrounded by a thickened ring and rarely recover under treatment but usually recover spontaneously after the child has become very active. Large openings usually have very thin margins and often recover with surprising rapidity when once retained by the button.

Operations for umbilical hernia are uniformly done by an incision above the navel with its convexity upward. The navel is usually preserved. The peritoneal covering is freed and tied off and the fascial ring is usually closed with chromic catgut by transverse overlapping. Subcuticular sutures of silkworm gut are used, the ends of which are tied over a minute gauze dressing, and the child's body is encircled by a wide strip of adhesive.

The most frequent abdominal sections are done for congenital pyloric stenosis, acute and chronic intussusception, and appendicitis.

I have naturally felt the seriousness of gastroenterostomy for congenital pyloric stenosis. None of us has approached Richter's recovery rate. I do not recall that any of the children I have operated upon have died as a result of the operation. They usually died from continued inanition. I do not think they should be placed in the wards with cases of inanition and enteric disturbances, but heartily advocate isolation of these children, who should be cared for by a nurse who does not come in contact with other children.

The ease with which the pylorus is found and delivered always tempts one to do a pyloroplasty. Usually the tissues are not sufficiently pliable to permit of the most popular of pyloroplasties. Dr. Stone of the Boston Children's Hospital recently told me of the success of Dr. Ladd and himself who have severed longitudinally the peritoneum and pyloric ring in the upper posterior quadrant down to the pre-mucosal connective

issue and the mucosa breed on either side the entire width of the ring. The mucosa at once protrudes into the gap and ought to prevent union of the severed ring. If we accept the theory that the hypertrophy is the result of frequent and violent contractions or that of spasticity of the pyloric ring the hypertrophy should rapidly diminish after coverage when it is put to rest. He does not lose the peritoneal covering of the pylorus. Dr. Strauss recently published a report of his work in which he bridges the gap with a flap from the under side of the muscle without opening the mucosa. Both operations are unique and are steps forward in pyloroplasty or congenital pyloric stenosis. Since my first two cases, done about eight years ago, I have limited my work to posterior gastro-entero-tomy. I shall try the Stone-Ladd operation in my next case.

When I consider the high mortality in acute intussusception I often wonder if our results could not be bettered by the more frequent use of enterostomy. In chronic recurring intussusceptions I feel that it would be better for most patients and for the maintenance of confidence in the certainty of our results if we did more resections. This procedure should be largely limited to the use of those who have the ability to do well intestinal anastomosis.

Appendicitis in very young children rarely comes to my service, but after three years of age the patients are relatively numerous. This affliction is handled the same as in adults except that I drain children for mild pathologic conditions for which in adults I would not drain. This practice should be especially followed in anemic and malnourished children.

I have been struck by the frequency of cases coming into the service with diagnoses of appendicitis giving suggestive histories and highly corroborative blood pictures, often with high pulse rates, most variable temperatures, sometimes pinched countenances, no regularity as to bowel conditions, general or localized abdominal tenderness, abdomen scaphoid or distended, and yet in whom there was no spasticity or tumor in the right iliac region. In spite of the general

clinical pictures I have relied largely on the absence of tumor and spasticity in rendering the opinion that these were not cases of appendicitis. The subsequent clinical course and their failure to return to the service later has tended to prove the correctness of the diagnoses. Two of these proved to be cases of acidosis, and two others obscure pneumonias.

Prolapse of the rectum is often met with. I look upon this as being usually due to follicular infections, resulting in hypertrophy of the mucous and perimucous structures. The pathologic secretions are irritating and the tenesmus induced establishes a cycle resulting in relaxation and ultimate protrusion of the rectum. Treatment is always directed toward relief of the follicular infection by use of frequent cold saline irrigations with the hips elevated. The children are kept in bed a long time in the recumbent position in freely ventilated rooms and given regular free diet and tonics as indicated. The buttocks are strapped together with adhesive. Cathartics and astringents are both irritating and usually should be avoided. So many of these rapidly recover upon such simple treatment that I am appalled at the radical operative measures so lately recommended for their relief. Our operative work has thus far been limited to cautery punctures or stripping the lateral and posterior walls of the rectum with the cautery. I have found it necessary on one occasion to remove vertical strips from the mucosa.

Branchial cysts only occasionally come into the service. Two thyroglossal fistulae have lately been dissected back to their origin.

In cases of cervical lymphadenitis where softening has not occurred, tonsils and adenoids are removed often putting an end to the difficulty. Operations for tubercular adenitis are always preceded or accompanied by removal of tonsils and adenoids. I usually use an incision along the full length of the anterior or posterior border of the sternomastoid through one of which I am usually able to reach glands in the remotest regions. In attempting enucleation I so often discover unexpected deep involvement, as was the teaching of Fenger, that I feel like returning to his method of starting out to do a radical adenectomy.

Three thymic resections have been done in the hospital in the last eight years. One of these children died of pneumonia, the others survived. I prefer a transverse skin incision about one and one-half inches long above the suprasternal notch, vertical muscle splitting, retraction, partial delivery, and partial removal. It has not been made sufficiently clear that all of the thymus must not be removed. When this is done in puppies it results in mental and physical defectives. In making the diagnosis, the clinical history, stridor, palpation of the upper border of the enlarged thymus, percussion borders, and X-ray findings must be relied upon. I consider bronchoscopic examinations as unnecessary to the diagnosis, and particularly dangerous to infants because of the prolonged anaesthesia and trauma which in vite bronchitis and pneumonia. If made they should precede the operation by a week or two to give opportunity for recovery from the trauma. The operation of thymic resection can be made remarkably simple.

My service has given especial attention to the clinical study of goiters in child life. We have found that these children are easily fatigued and always show some form of deficiency which is most variable in its gravity and manifestation. I think the syndrome of simple goiter, which I have described, is the result of chronic toxæmia. Since our observations began I think I am safe in saying that every child we have examined presenting a goiter has shown hypertrophied tonsils which usually contained pus or cheesy material. Two brothers having large goiters and severe acne, lately had tonsillectomies and showed marked diminution in the size of their goiters within a week and subsequent slow improvement. A pale malnourished girl with a very large goiter and having a bad blephoritis marginalis which did not improve under treatment, had this almost disappear in three weeks after tonsillectomy and with marked general improvement and diminution in size of goiter. Dr David Fiske recently removed for me the tonsils of a robust Jewish girl with a very large thyroid and at the end of a week reported that he thought the gland had diminished in size about 50

per cent. All of these were diffused enlargements of both lobes showing no nodulations and occurred in children after the pubescent period.

Younger children with goiter seem to most commonly show recognizable enlargement of the gland between the ages of seven and ten, and it usually begins in one of the lower poles of the thyroid, usually the right, in the immediate neighborhood of the entrance to the thymic lymph-channels which drain into those of the thyroid at this point in both lobes. The almost uniform location of the beginning of goiters in early childhood at this point and the uniformity with which these show pathologic tonsils suggests that the primary hypertrophy of the thyroid results from an extra effort to detoxicise or to destroy bacteria which has escaped the cervical and mediastinal lymphatics, and instead of being passed to the thoracic duct is segregated and passed to the thymus and then to the thyroid. We commonly see ten or more of these goiters each clinic day and have seen as many as twenty-two in a day. It is noteworthy that out of this large number I have never seen a single patient showing enlarged cervical lymph nodes. This would suggest that the bacterial flora of the tonsils in these cases have a selective tendency and certainly do not attack lymph glands. Operations on the thyroid are not often necessary in ordinary hypertrophies of the thyroid gland in child life. I am now removing focal infections then attending to anæmias and give thyroid extract if the goiters continue. Advanced pathologic changes in the gland are dealt with as in adults.

It is difficult to retain head dressings upon young babies. This may be successfully done by a four-tailed gauze covering tied beneath the chin and behind the neck, making a bonnet.

In turning back skull flaps in babies after making the trephine openings, scissors may be used instead of ronguers to cut the bone flap. This is a great time saving step and diminishes trauma to the cortex.

Patients with hydrocephalus are presented with painful frequency. Examinations should always include retinoscopy. Many

of these children are blind. The varying causes of hydrocephalus and the varying pathology must be borne in mind; therefore it is absurd for us to place faith in any one operation. In one of our cases, upon entering the dura I found no cortex. The calvarium was filled with fluid. Upon post-mortem we found at the base a deformed pons attached to a little brain matter spreading out to and blending with the dura at the base, the total mass of remaining brain not exceeding the size of two hen's eggs.

No true Jacksonian epilepsies among children have come under my care. A number of exploratories have been done for epilepsy at the suggestion of Dr. Rothstein. It is worthy of notice that many of these had normally developed skulls but atrophic or sclerotic brains with poorly developed convolutions. These brains came far from filling the skulls and there was much subpial edema. In such cases one looks upon a translucent, jelly-like area of yellowish color. I call attention to this because this condition is so often taken for cortical cysts and efforts made at removal or drainage. Post-mortem usually shows this condition generalized. Only two of the surviving patients have shown improvement. In this group our efforts have been directed toward diminution in size of the skull, thus to compress the brain and diminish the edema. Large bony flaps have been removed on one or both sides, the pericranium was left and sutured in place. The same finding occurs in many long-standing cases of spastic paralysis for which the same operation has been performed and has thus far been without benefit.

Recent cases of Little's disease can and must be diagnosed early and usually operated upon at once. Results have been very fair both as to life and prevention of spasticities.

The splinting of fingers and hands of little babies is difficult. They easily worm out of their dressings. Injured fingers may be dressed and then splinted by four tooth-picks laid at equal distance on a strip of adhesive. This is rolled about the thin finger dressing. A bandage fixes this to an adjacent finger. A few wraps are taken

around another finger. A tongue depressor is bound to fingers, hand, and forearm and all put in an anterior splint.

Fractures of the elbow are the most common of arm fractures in our service. I think fractures of the capitellum are usually mistaken for dislocations; they are easy to reduce and the results are excellent. X-rays are taken of all fractures and reductions are made under anesthesia. Correct position is the best splint and the best insurance against an obstructing callus and future limitation of motion. The arm in elbow fractures is always put up extended or at that angle giving the best approximation. Right angle and extremely flexed positions often give the most extreme displacements. We have had no regrets. No early massage or passive motion is indulged in. These are the best methods of breaking up embryonic tissue, exciting extra callous formation and creating fixity. I favor open operations to correct irreducible malpositions but rarely plate children. Where temporary fixation is required I often use Albert's staples. Angulation in the long bones resulting from union in malposition is corrected early by slow bending; if old, by subcutaneous osteotomy when applicable. Many terrible deformities seen upon the X-ray plates turn out to be good clinical results after eight to twelve months. Angles in bones of young children straighten partly by elongation and partly by spontaneous correction.

Fractures with displacements in the upper half of the femur in infants are difficult problems. We use no one treatment. Casts with or without extension as indicated are preferred. When brace shops are at hand we shall use crowding braces for these little folks. Vertical extension with abduction does not always provide the desired result. It is too generally applied and too much reliance is placed in it without due regard for many adjuvants and other methods.

Bow legs are treated by osteoclasis with excellent results in younger children, but in older children I consider single or multiple subcutaneous osteotomy to be the operation of choice. As a general surgeon I feel ob-

ligated to our orthopedic colleagues for what has been accomplished in this field by the foregoing methods but I wish to condemn as dangerous and unnecessary routine open osteotomies for bow-legs and knock-knees. I am afraid that both general and orthopedic surgeons are forgetting the possibilities of effacement of bows by the elongations of growth and the results obtainable by the use of fats, phosphorus, and tonics. I have seen more than one bow legged patient straighten up perfectly upon medical and dietetic treatment when the treatment was undertaken early in life.

Injuries either to the bones or soft parts of the lower extremity requiring long rest in bed are frequently followed by relaxation of the ligaments at the knee and knock knee ensues. These should be treated early by overcorrection and long casts or braces. If they persist they should be corrected by subcutaneous osteotomies.

In acute osteomyelitis increasing experience has taught me to operate when clinical signs are present. Too often these clinical signs are disregarded because the X ray shows no focus and when the second plates are made there is often great bone destruction shown. When clinical evidences are present one may at least drill an opening in the bone cortex to lessen tension and thus limit destruction.

Scurvy is often overlooked and when seen in the X ray plates may be looked upon as syphilis. Other symptoms than bone changes should be sought.

Bone syphilis is an important and frequent affliction in child life. X ray plates are very valuable aids in diagnosis.

Operations for harelip have been uniformly satisfactory. I use horsehair sutures and either no dressing or tincture of benzoin spread on the surface. No tension sutures are used. The cheeks are held together by zinc oxide adhesive cheek-covers united with silk thread, which is held up off the lip by rolls of gauze placed just outside the angles of the mouth.

Cleft palates are united with horse hair. A straight five eighths-inch Hagadorn needle is used in placing all but post-alveolar sutures.

I rarely use tension suture and seldom make the Langenbeck lateral slits.

My wards nearly always contain a number of children who have been burned. Such accidents to these little children seem so unnecessary since many are due to the children tipping scalding water upon themselves or falling into receptacles containing hot water. It seems that warnings by public health departments and the press would not be effectual because they would require continual sounding and would rarely reach the parents of these victims who do not read. The large death-roll and our own helplessness to prevent many of these deaths is depressing. These children commonly die suddenly after a period of undue ease and brightness or delirium. Those who survive have been treated with satisfaction by the open-air method, allowing the secretions to dry on the wound. Healing is rapid for a time, but in severe cases it finally becomes sluggish when the abraded areas are strapped tightly and smoothly with zinc oxide adhesive, which hastens repair beyond my first expectation. These are dressed every two to four days. Both methods seal in to some extent the wound secretion. At any stage of repair this secretion may become toxic and the situation serious. The first evidence of this is usually loss of appetite followed by vomiting, elevation of temperature, and later by coma and sometimes convulsions. I have learned to abandon either method when the first toxic symptoms appear, keeping the wound free from crusts, dressing with gauze wet in normal salt solution twice daily until the toxic symptoms disappear.

In conclusion let me add a word to my surgical friends about the value of council with pediatricians in pediatric surgery. Our work is limited among this class of patients, we are not as familiar as we may think with diagnosis or the therapy of children, and it is my earnest belief that each of us will find the convalescence more smooth and the safety of young patients increased when, if the child is not doing well, we have the child's internist examine it and direct its feeding and medication, there is no field in which the internist is of greater or more unexpected assistance.

BIBLIOGRAPHY

- 1 KELLY, SAMUEL W. *Surgical Diseases of Childhood* 1000
- 2 BERNHEIM BERTRAM *J Am M Ass.* 1913, Oct 9, 1378
- 3 HELMHOLTZ HENRY *Am J Dis Child*, 1915, 7, 194

- 4 GRAHAM, LAERTS A *J Exp Med.*, 1915, xli, 185
- 5 BLFORD, COLFMAN G. Simple goiter a compensatory hypertrophy. *Illinois M. J.*, 1914, July
- 6 Idem Goiter in children *Burg, Gynec and Obst* 1913, xx, 35
- 7 Idem *Surg., Gynec & Obst.*, 1913 xii, 617

PATHOLOGICAL FINDINGS IN RETRO-INGUINAL HERNIAS

BY DR. RICARDO FINOCHIETTO, BUENOS AIRES, ARGENTINE

RETRO-INGUINAL hernias (Corbellini 1906) are the classical direct hernias, the internal hernias of Tillaux, the "juxtafuniculares" of Villette. Retro-inguinal hernias are found in 10.63 per cent of the cases coming to operation. All cases of rupture should be studied further than the simple consideration of the inguinal canal and the hernial tumor. In retro-inguinal hernias there is a distinct difference from the picture presented in oblique hernias. The conjoint tendon instead of being directed obliquely downward and inward in front of the rectus muscle to be inserted in the pubis, is directed transversely inward to join the outer edge of the rectus. Owing to the atrophy of the fibers of the conjoint tendons, the rectus edge is visible for 4 or 5 centimeters. We thus have on the inside the external border of the rectus, Poupart's ligament below the inferior edge of the internal oblique and transversalis muscles above making a triangular space the outlet of the retro-inguinal hernia as has lately been described by William Hessel. In all our cases there was atrophy of the conjoint tendon and Hessel's triangle. The cremaster muscle was absent in most of the cases, especially its internal border, which we have found but once.

The hernial tumor is only loosely attached to the cord and to the floor of the canal at its upper end, but at its base it is firmly bound, owing to the continuity of tissue. Its form varies according to its size from the simple dome-shape to the true sac. The hernial tumor is formed by the transversalis fascia, peritoneal fat and peritoneum, and may

contain any of the organs of the abdomen or organs likely to be found in a hernia. In the base of the tumor which is always very broad fibers are found which serve to reinforce the transversalis fascia. These fibers run almost horizontally inward and below and are most abundant and strong in the upper part. In front of these, other fibers are sometimes seen directed upward and inward which belong to Hesselbach's ligament. The transversalis fascia overlies the peritoneal fat to which it is loosely attached. This fat is most abundant toward the inside where it begins to take on the appearance of the prevesical fat. On the outside the fat surrounds the epigastric vessels which lie immediately below the fascia. Lower down against Poupart's ligament this fat is generally abundantly vascularized. The peritoneum does not present any peculiarities except for its great thinness.

These may be said to be the general characteristics of all retro-inguinal hernias. A careful review of our cases shows that there are various types and the consideration of these would seem to justify a division into three varieties which we should name according to the predominant element, viz., sacular, lipomatous and splanchic enumerated in the order of their frequency. In the first variety (Fig 1) the tumor in most of the cases is hemispherical but in large ruptures it may present a long sac. It is made up of the transversalis fascia, more dense in the base, peritoneal fat which is scarce at the apex and abundant at the base, and a third layer, the peritoneal sac. If we pull the sac toward us, we will find on its medial

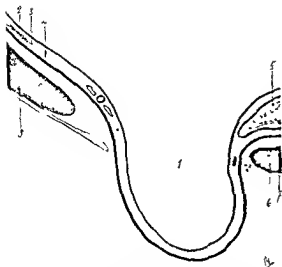


Fig 1 Saccular hernia

1 Saccular cavity, 2, peritoneum, 3, properitoneal fat and deep epigastric vessels, 4, transversalis fascia, 5, bladder, 6, prevesical fat, 7 rectus muscle, 8 wide muscles of the abdomen. 11, stump of the obliterated hypogastric artery. Schematic drawing following the great axis of the hernial tumor horizontally.

side the bladder and sometimes the cord of the obliterated hypogastric artery in the middle of the prevesical fat. This is noted as a reddish, white flat cord passing above and to the inside. On traction motion is transmitted to the navel. During the operation it is easier to investigate this by pressing on the navel through the towels when the umbilical cord is stretched.

On opening the sac nothing of importance is noted. The fingers should always explore the peritoneal cavity and the inguinal fossa, for on several occasions we have found an co existing oblique hernia on the same side.

The variety just described has been found in 73 per cent of our cases and we have named it the saccular type.

The second or lipomatous type is shown in Fig 2. To the inside of the cord in a portion outside the canal is found a clear yellow lobule of fat attached to it by a thin connective tissue. This lipoma completely encapsulated presents a strangulation which corresponds to the external ring. Beyond this it bulges out in the form of a funnel presenting the

same characteristics as the other varieties. If this lipoma is cut in its sagittal plane from its tip to its base, at its neck will be found the cavity lined by smooth connective tissue resembling the interior of a hernial sac. If the finger is introduced into this pseudocavity the mass may be removed down to the peritoneum. In one case the cavity was so large we could get a whole pair of scissors into it without difficulty. This connective-tissue space which is located in the properitoneal fat limited above and outside by the sac is nothing but a prolongation of Bogros' space. The sac is always small, simply a peritoneal infundibulum with very thin walls covered by a layer of fat. To find it one must cut through the base of the tumor in its supra-external portion immediately inside of the deep epigastric vessels.

This marked preponderance of fat over the other elements in the hernial tumor is our reason for naming this variety the lipomatous hernia to differentiate it from the variety of oblique hernia known as *hernia adiposa*. Lipomatous hernias occurred in 20 per cent of our cases.

We call the third variety *splanchnic* since a viscus takes part in the formation of the tumor. The *splanchnic* hernias are large and partially irreducible. The transversalis fascia is only apparent at the base of the tumor. Within the sac is seen a fatty mass which has all the appearance of the omentum changed by an inflammation. This clear, yellow fat prevents one from seeing the vessels. A few milky spots on its surface and its adhesions to the sac complete the picture of omentum. This fatty mass is attached by a mesentery to the internal part of the sac. If a finger is run along the tumor it will be found to go behind the pubis instead of upward as it would in tracing the pedicle of an epiplocele. This enables us to differentiate these hernias from inflamed and adherent omentum. If we cut through the peritoneum it may be dissected out easily. Under a layer of fat, not thick and a little vascular, the bladder is found and at times other pelvic viscera. The bladder is the most frequent of all organs found in these hernias. The fat which lies on its internal side and in the neighborhood

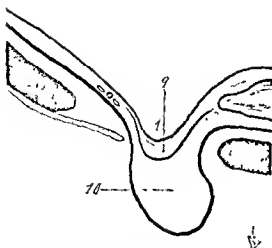


Fig 2 Lipomatous hernia

1, sacular cavity; 9, prevascular, detachable space; a, prolongation of Bogros space; 10, lipoma. Schematic drawing following great axis of hernial tumor.

of its tip is reddish yellow crossed with thick veins and contains the hypogastric artery. In the space of Retzius there is no room for the herniated portion and to reduce it we must make a space by the division of the tissues. Great difficulty is found in these cases in identifying the deep epigastrics.

The third variety, the splanchnic hernia, was found in 6 per cent of our cases. Now one may ask, are these three pathological forms different entities or are they variations in the evolution of the hernia? A priori the latter hypothesis would seem to be true. The hernia begins in the lipomatous form, ends in the atrophy of the fat together with a gradual increase in size of the sac, ultimately producing a sac containing some viscus. However a study of our statistics leads us to a very different conclusion since lipomatous varieties have been found which persist for seven or eight years without any treatment, and splanchnic cases have been found which

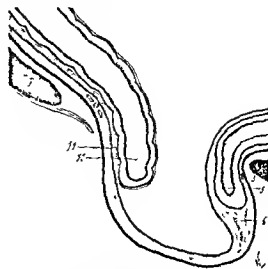


Fig 3 Splanchnic hernia

5, Bladder; 9, prevesical fat; 11, fascia 'd' accolement' (Lardennoir and O. Kinezie); 12, large intestine; 13, stump of obliterated hypogastric artery. Schematic drawing following great axis of hernial tumor.

develop in one year to a large size having had from the beginning the characteristics of the splanchnic variety.

These facts lead us to believe that the right inguinal hernias may be divided into three distinct, separate entities as mentioned above, and that each of these may be varied by local conditions. In the first two varieties there is generally a more resistant canal. The internal ring is not very large and the tissues in general are less relaxed. In the splanchnic variety all the conditions which favor the growth of large ruptures are present, aplasia, general relaxation of the tissues, the flaccid abdomen and the superabundance of fat, the inguinal canal does not exist, the external ring is very large, the preperitoneal fat, the length of the mesentery, the very large fat appendix, the prostatic enlargement, altogether produce a condition favoring mobility of the viscera and easiness and simplicity of production.

THE TREATMENT OF CHRONIC NON-TUBERCULOUS EMPYEMA¹

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CERTAIN thoracic diseases which for generations have fallen to the lot of the surgeon are yet badly handled. Conspicuous among these is that patriarch of the surgical scrap heap, chronic empyema. There is obvious opportunity for improvement in the treatment of this disease.

A patient thus afflicted presents a typical picture that of a stooping, one-sided, emaciated, pale, clubbed fingered individual—not seriously ill, but nevertheless a chronic invalid. He oscillates daily between the surgical dresser's room and the park bench, his family meanwhile suffering the poverty incident to his inefficiency. There is generally an opening somewhere in his chest. It has been there for from 6 months to 25 years. He is the survivor of one and perhaps of several operations, and yet pus continues to discharge from his side. The surgeon passing through the dispensary recognizes one of these unfortunates and proverbially remarks to himself "Some day when there is a shortage of more interesting material I must take out some more of that man's ribs." The patient meanwhile continues the object of procrastination and neglect.

It may be said that the chronicity of these cases is rather more the result of the surgeon's lack of persistence in bringing his patient to the point of cure than it is to ill choice of method or lack of surgical skill.

LOCALIZATION OF CAVITY

Assuming that the diagnosis of chronic empyema has been made the first step in treatment is the determination of the size and location of the persisting cavity. This of course, depends upon the direction and extent of lung retraction. Auscultation and percussion as a means of diagnosis are valueless or to say the least so inadequate compared to other methods at our disposal that they may be disregarded.

If a sinus in the wall of the chest has been

produced *per necessitatem* or by previous operation, an olive tipped flexible probe if inserted into the cavity will at least disclose the longest diameter. If rotated within the cavity the arc expressed by the olive tip may be noted from the corresponding rotation of the flattened handle. Thus the lateral diameters may be estimated with surprising accuracy.

Stereoscopic roentgenograms contribute in the localization of a cavity according to circumstances. If the empyema is of long duration and has never been drained, the roentgen ray will cast a deep shadow which is continuous with and not distinguishable from the adjacent thickened pleura. The actual size and location of a cavity is therefore not demonstrated. If the pleural pus has been draining through a bronchus, pyopneumothorax is present, a fluid level is shown. The empty part of the cavity is outlined and the shape of the remainder may be roughly estimated. If the cavity has been drained through the chest wall and is practically emptied of its contents, the stereoscopic roentgenograms will portray the outlines of the cavity in a large proportion of cases. The exceptions are those instances in which the cavity is not situated in the usual lateral portion of the chest (Figs. 1, 2) but rather anteriorly or posteriorly (Figs. 4, 5). Under such conditions the lung is not thrown in silhouette as in cases in which there is a lateral cavity, but rather overlies the cavity and its own markings obscure the cavity outlines. It would seem that the stereoscope would overcome this obstacle but unfortunately such is rarely the case.

By far the most accurate and satisfactory method of outlining cavities associated with a sinus of the chest wall is the following: A narrow bandage or tape is unwound and immersed in barium sulphate and water mixed to the consistency of thin cream. With a probe it is fed through the sinus into the

¹ Read before the Minnesota Valley Medical Society, September 27, 1923, Des Moines.

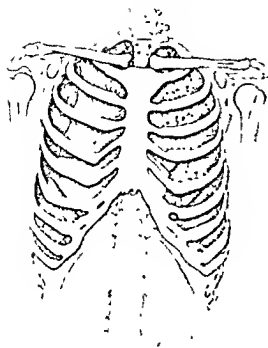


Fig. 1. Diagram. Small lateral empyema cavity. The most common type, generally demonstrable in radiogram. Curable by shrinkage type of operation, with any form of lung operations. Sterile or not necessary.

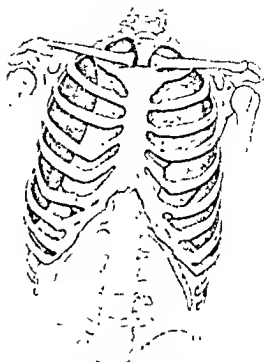


Fig. 2. Diagram. Large lateral empyema cavity. A type demonstrable in radiogram. Curable by decortication and shrinkage type of operation. Sterile or not necessary.

care being taken that each loop of the tape is carried to the limits of the space until it is picked full. A stereoscopic radiogram is then taken (Figs 9 to 10). The mass of barium soaked tape casts a definite shadow which is distinguishable from the lung shadow even when the two are superposed as in the anterior and posterior cavities mentioned above.

The injection of liquid mixtures containing ismuth or barium has long been utilized in conjunction with the roentgen ray to demonstrate empyema cavities. It is often difficult to completely fill the cavity with such mixtures. If a bronchial fistula is present a sudden flooding of the trachea may occur, the consequences of which are rarely fatal but sometimes alarming. Ismuth retained after such infections, particularly when the sinus is small and the outflow is obstructed, may

lead to a moderately severe reaction; this is an unwelcome incident in the course of a purely diagnostic measure. Suffice it to say that the packing with barium soaked tape is simpler, safer and equally efficient in demonstrating cavities.

The cystoscope has been employed to survey empyema cavities. There is little to be derived therefrom.

The diagrammatic drawings shown in Figs 1, 2, 3, 4, 5, 6, 7 and 8 were made from a skeleton thorax in which the retracted lung was modeled in wax in many of the positions in which the water has found it at operation. To these might be added illustrations of the many types of smaller cavities resulting from localized septal effusions including the particularly rare form of interlobar empyema.

PRELIMINARY DRAINAGE

It is plainly apparent that no one method

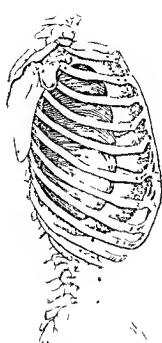


Fig. 3

Fig. 3 Diagram Lateral view of cavity shown in Fig. 1. Illustrates the enormity of any osteoplastic resection undertaken previous to an attempt at decortication.

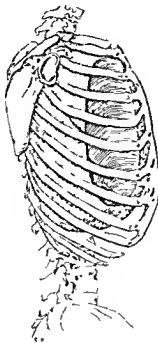


Fig. 4

Fig. 4 Diagram Anterior cavity. Not demonstrable by radiogram except in lateral view or in conjunction with

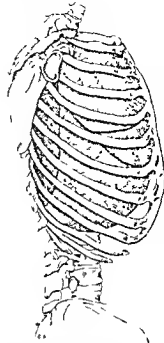


Fig. 5

barium soaked bandage pack. Suitable type for Schede osteoplasty combined with muscle implantation. Also suitable for the unfolding lateral flap operation.

Fig. 5 Diagram Posterior cavity. Particularly suitable for the lateral flap infolding operation.

of treatment nor any one type of operation would be suitable for all chronic empyema cavities which assume such a diversity of size, shape, and location. Nevertheless one cardinal rule of treatment may be laid down at the outset which is applicable to them all. No operation designed for the obliteration of a chronic empyema cavity should be performed until this cavity has been provided with wide open drainage at the lowest possible point for a period of at least 6 weeks.

The case to be treated presents one of the following conditions:

1. An incarcerated accumulation of pleural pus which has remained unrecognized and undrained for months and even years.

2. A cavity which "leaks" but does not empty through a bronchial opening, situated generally at a level far above the bottom of the space.

3. A cavity which leaks an absurdly small proportion of its contents through an empyema necessitatus opening in the chest wall.

4. A cavity which drains profusely and yet incompletely through an operative wound from which the drainage tube has been prematurely removed.

In each and all of these conditions the patient is the unfortunate carrier of from a half pint to three quarts of residual pus. He is suffering from a chronic low grade septic absorption. He is a poor surgical risk, particularly for the type of operation to which he must eventually be subjected.

A preliminary drainage operation is therefore indicated in nine tenths of the cases first met in a surgical clinic. The bottom of the cavity is located with an exploratory needle attached to a tight glass barreled syringe. It matters little whether or not there are already openings in the chest, generally they are too high and too small to be regarded. Through such openings a curved probe may aid in locating the real bottom of the pleural space at which point an inch of rib is resected and a large tube inserted.

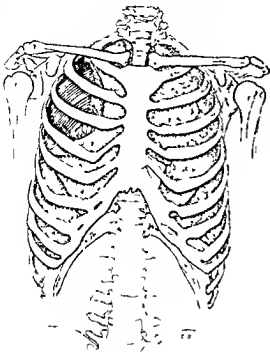


Fig. 6 Diagram Type of chronic empyema cavity which may follow pneumonia of the upper lobe. External type of operation indicated

The improvement of a patient thus provided with new drainage is striking. There may be a weight increase of twenty pounds in a few weeks. Then and not until then is radical operation to be undertaken.

TREATMENT WITHOUT OPERATION

This subject is scarcely worthy of discussion. Generally speaking, non-operative treatments in chronic empyema are attended with cure only in those patients who would have recovered eventually and with like promptness without any treatment. It is an established fact that fibrous connective tissue formation on the pleural surfaces occurs with slow but regular growth, diminishing the capacity of the cavity accordingly. Shrinkage of all tissues associated with some demerol further contributes to the obliteration of the pleural space. It is not surprising, perhaps, that the enthusiastic physician employing some non-operative method, credits

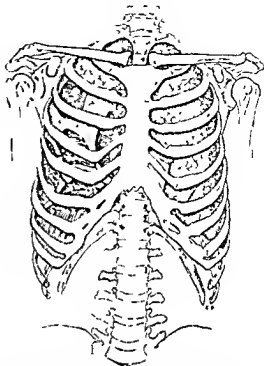


Fig. 7 Diagram Multiple encapsulated empyema cavities. Generally fatal in the subacute stage because of impossibility of diagnosis and localization. Drainage operation evacuates one cavity only

the apparent improvement to his therapy rather than to the physiologic processes which have meanwhile been at work.

Thus the vaccine enthusiast receives his regular pittance for months. His conscience is relieved by the apparent diminution in the amount of discharge. The patient is temporarily encouraged and he notes further that the discharge is less offensive. From these facts, both assume that the cavity is much reduced in size. Vaccine therapy is indicated for symptomatic relief. It will not cure. There is no real evidence that any of the physiologic healing of processes in the pleural cavity are fostered or stimulated by vaccines. The subject is worthy of mention only in the sense of caution. Vaccine therapy has done far more to postpone unnecessarily the obviously necessary surgical procedure than it has ever done even in the relief of symptoms.

Bismuth and vaseline (Beck's paste) is commonly used as an injection. Thus form

of therapy has definite limitations which were lamentably overlooked until a number of disasters emphasized them. The mixture has a definite bactericidal action upon the secretions of septic cavities. When an empyema cavity has thus been rendered sterile the tendency of the chest-wall opening is to close. The cavity remains. Both physician and patient rejoice at a cure which is far more apparent than real. If the outflow of the infected mixture has been incomplete during the treatments, the bismuth incarcerated in the large cavity may gradually produce symptoms of bismuth poisoning. Fatalities unquestionably have resulted. Furthermore months or even years after the closure of the sinus and the apparent cure of the patient, febrile symptoms have developed with all the other indications of retained infection within the chest. If drainage is not re-established an empyema necessitatis may develop in the scar to the surprise and mortification of the physician who hnds on further examination that a large cavity still persists which, though temporarily sterilized by the mixture has through blood or lymphatics become reinfected with dire results.

Empyema cavities of more than six or seven ounces capacity should not be injected with bismuth and vaseline except to reduce an overabundant secretion by lowering the toxicity of the infection. In such usage care should be taken that the mixture injected is provided with free, unobstructed escape.

Small empyema cavities either primarily small or rendered so by previous operations may be injected with the deliberate intent to sterilize them and to heal their drainage openings. The physician should acquit his patient with the fact that the apparent cure resulting may not be a permanent one, advising him further that upon the appearance of any untoward symptoms he should return for consultation and perhaps for reopening of the sinus. Certain observers have been sufficiently cautious in employing this therapy to aspirate with a needle the persisting closed cavity from time to time to determine the degree of obliteration and the endurance of the sterilization.

The non-operative treatments of chronic

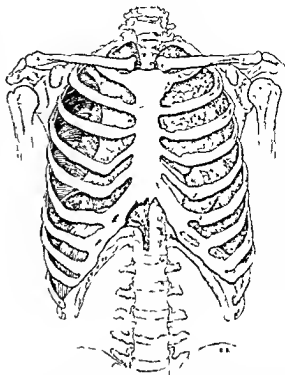


FIG. 8. Diagram. Combined lateral and diaphragmatic empyema cavities not connecting. Accurate diagnosis generally impossible. One cavity generally drained, the other overlooked. Particularly adapted to operation of Latent type.

empyema then, some of which have been mentioned in the foregoing, must be employed with caution and with understanding as to the occasions when they are indicated.

SURGICAL TREATMENT

The necessity of preliminary drainage at the extreme bottom of all empyema cavities previous to more radical procedures for obliteration has been emphasized. The patient returns 6 weeks or 2 months after this preliminary with his maximum resistance. An operative fatality is now inexcusable. It occurs for definite avoidable reasons.

1. When an attempt is made to accomplish the obliteration of a large cavity in a one stage operation.

2. When there is an erroneous conception of the degree of resistance possessed by a given patient together with an operative procedure which overtaxes his resistance.

3. When the atrocious custom is employed of operating upon these patients until symptoms of shock appear, with ignorance of the fact that the maximum shock after such osteoplastic operations is not demonstrated until after 2 hours

4. When there is undue regard for hamostasis, loss of blood being far more contributory to shock in such cases than trauma

5. When there is an excessive expenditure of time

6. When the administration of the anæsthetic is unskillful

The operations may be discussed as being of two types, each designed to further one of the two physiologic healing processes, namely, shrinking of the diseased half of the thorax, or actual filling of the empyema cavity itself. Any attempts to fill the cavity are necessarily accompanied by a certain degree of shrinkage because of the rib resection necessary to permit accessibility to the cavity. Operations designed for shrinkage, however, may not contribute in the least to actual filling. For example the Wilms operation consists in the resection of one-half inch segments of several ribs at their angles posteriorly and at the costochondral juncture anteriorly. The normal curve of each rib from angle to cartilage remains unaltered. Approximation of the shafts of the ribs is promoted nevertheless by the release of their anchorage front and back. A moderate degree of slumping of the costal arch at the sternal and vertebral ends may also occur. In other words by this type of operation the lateral thoracic diameter is reduced. The lateral contour is considerably flattened, but one fails to produce any actual caving in over the cavity area which could be said to contribute to its filling.

The Estlander operation consists in the excision of several segments of several ribs in any portion of their shafts. A moderate degree of local slumping of the thoracic wall may occur after the more radical operation of the Estlander type although its function is essentially to produce a uniform shrinkage. In fact, it was the failure of Estlander's operation to contribute to any marked degree to the obliteration of a cavity which led Schede to describe his operation the very nature of which

accomplishes a local chest wall collapse. Estlander's name is commonly attached erroneously to operations of the Schede type. One effects shrinkage alone, the other both shrinkage and collapse.

The distinctive feature of the Schede operation is the complete removal of the bony wall of the empyema cavity; in other words, the free resection of all ribs overlying the cavity regardless of the number or extent (Fig 12). Schede also recommends the removal of the thickened parietal pleura lying beneath the resected ribs and forming the outer lining of the cavity (Fig 13). He thus sacrifices a layer of tissue often more than an inch in thickness, increasing one diameter of the cavity correspondingly. He argues that the removal of this leathery, unyielding layer permits a more complete slumping of the skin and muscle flap into the depths of the cavity, thus gaining more in the obliteration of the space than was lost by the sacrifice of the connective tissue mass which nature had labored perhaps for several years to produce. He adds that the muscle surface now forming the outer wall of the cavity will granulate rapidly and aid further in the filling function.

Even the Schede operation, radical and mutilating as it may seem, often fails to accomplish its primary purpose, namely, to produce filling by local slumping. Probably a Schede type of operation was never performed without a certain degree of reduction in the cubical contents of a cavity. This, however, may be explained more by the general thoracic shrinkage which such an extensive rib resection obviously permits, than by local filling. These are two explanations for this "filling defect" (to borrow a roentgenologic term). If the skin and muscle flap are sutured accurately to their original position a tense somewhat tightly drawn covering is provided to the cavity, which spans the space but does not enter it. If, thanks to the paucity of ribs, the skin and muscle flap at first spread loosely over the gap, the healing contractions tighten it later into a spanning membrane.

Another explanation of the frequent failure of the Schede flap to assume the concave

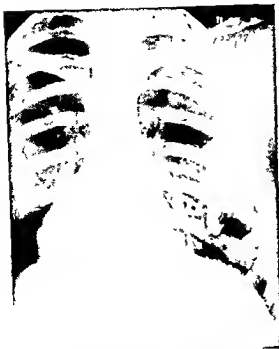


Fig 9 Radiogram of empyema cavity packed with barium soaked tape showing that a tortuous narrow cavity may be thus packed. Illustrates type of cavity suitable for antiseptic injections (Beck's Paste)

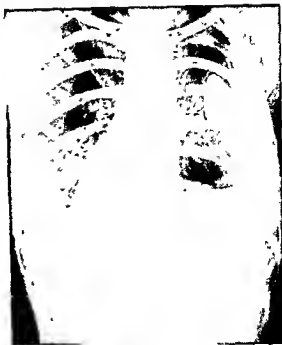


Fig 10 Cavity, incompletely demonstrable by radio gram alone, defined by barium soaked pack

curve of the cavity is to be found in the error of dividing the covering ribs in such manner that their ends directly overlie the borders of the empyema gap. A rigid bony rim is thus provided to the cavity over which the flap must make an abrupt pitch in order to follow its curve. If on the contrary the ribs are divided an inch beyond the pleural limits of the cavity, the pitch is a more gradual one.

The Fowler-Delorme operation of decortication is designed to fill the empyema cavity from within, the Schede type seeks to fill from without. The Fowler operation theoretically at least aims to obliterate chronic empyema cavities in the ideal fashion. It not only should minimize deformity of the contour of the chest wall but also by ridding the lung of its thick pleural covering favor its re-expansion thus restoring more nearly its full respiratory function. All other osteoplastic operations for this disease deliberately abandon the lung itself to its retracted state

and to its impaired function. The technique is not elaborate or difficult of execution. Several inches of several ribs in the region of the cavity are resected. Some parietal pleura is removed producing an opening through which instruments and fingers may strip the visceral pleura from that portion of the lung forming the inner wall of the cavity. Thus liberated, the lung should expand. When it does, the picture is awe inspiring. The cavity appears to be filled from the bottom up.

Ransohoff's operation is a modification of the decortication type. The visceral pleura is not stripped but incised with multiple cuts intended to reduce the tenacity of the fibrous pleural layer so that it yields to the ever-present tendency of the lung to expand.

Appearing as the operation of the Fowler-Delorme type may at first appear, the results are not infrequently disappointing. The area of cleavage below the visceral pleura is not always unobstructed. Fibrous bands may cross from the thickened pleura to the interalveolar connective tissue of the par-

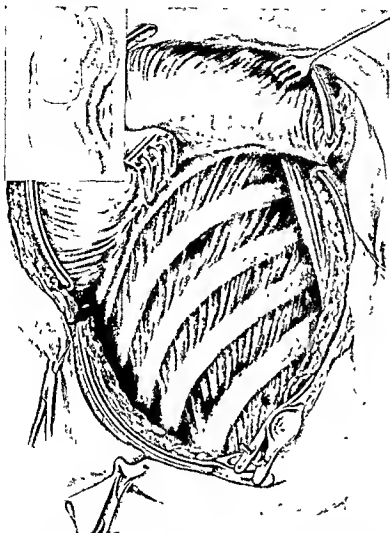


Fig. 11. Chronic empyema, cavity filling by muscle implantation combined with operation of Schede type. First step. Reflection of skin and muscle flap. Note curved clamps (without handles) to check muscle bleeding.

hyma of the lung. In freeing these, lung tissue may be lacerated, causing bleeding and multiple minute air fistulae. Hemorrhage may necessitate the termination of the operation before the completion of the decortication, the degree of cavity filling is thus disappointingly minimized. Lung infection has resulted from the laceration of the peripheral spaces. Fatalities have occurred from each of these complications.

If on the contrary the decortication is readily executed and the lung during a forced expiration of light anesthesia appears to occupy the pleural space the new relations are difficult to maintain. The lung may be temporarily inflated and forced even to approximation with the chest wall but in the presence of an open chest neither negative pressure nor pleural capillarity are present to retain the expansion. To reproduce the nor-

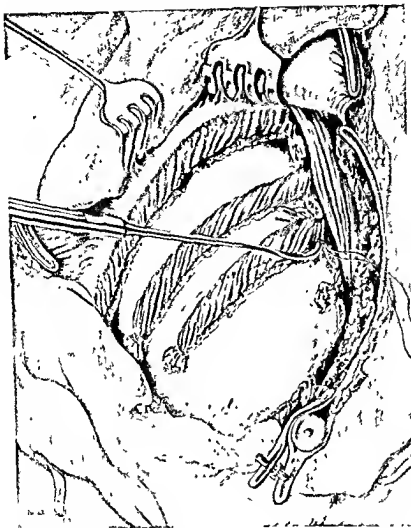


Fig. 12. Muscle implantation operation. Second step. Ribs have been resected subperiosteally. Ligation of intercostal bundles.

mal suction effect of the chest-wall one must close hermetically the operative wound. By so doing one must also imprison infection within the diseased pleural cavity and local accumulations of pus are dangerously likely to occur. Efforts have been made to suture the inflated lung to the parietes, but unfortunately one secures apposition of suture lines rather than of surfaces. Pocketing of infection is again imminent. Positive pressure breathing exercises are religiously carried out during convalescence to maintain inflation

but agglutination between the intermittently opposed surfaces does not willingly occur. The fibrous parietal pleura presents a slimy surface to which even the freshened surface of the lung may not adhere. The authors of the operation emphasized the necessity of removing both the visceral and parietal pleura in order that two raw surfaces might be brought in apposition. Surgeons of late years have rarely attempted the stripping of the parietal pleura. It prolongs an already severe operation and is generally omitted.



Fig. 13 Muscle implantation operation Third step Thickened parietal pleura in process of removal

Decortication then, though in given instances of unquestionable value, has its limitations. It contributes to the cavity filling to a greater or less degree, it rarely obliterates it.

Inadequate as the osteoplastic resections and the decortications may sometimes appear, it must be admitted that what we have termed the filling type of operation is far more effective in obliteration than the shrink-

age type. The use of foreign material such as paraffin for filling purposes has not been sufficiently successful to be convincing as to its value. The injected mass may at any time induce the signs of foreign body irritation. Deliberate transplants of fat or muscle have failed to graft. The blood supply of the fibrous pleura is far too meager to assume completely the nourishment of isolated tissue. If, however, muscle is swung into

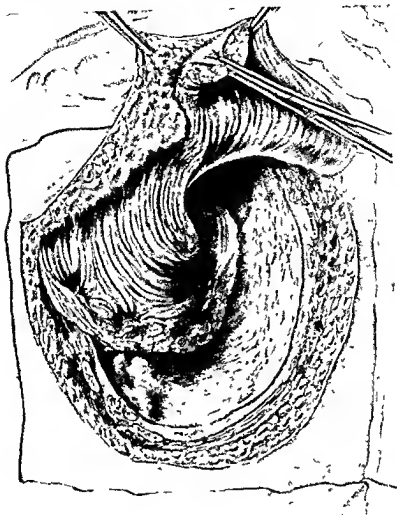


Fig 14 Muscle implantation Fourth step Iatissimus muscle has been split, one-half has been dissected from U shaped flap and sutured into top of cavity, the remaining half is to be implanted likewise Note important lateral sutures to muscle to relieve tension upon stitch at tip of flap

an empyema cavity as a pedicled flap preserving its original blood supply, it can be relied upon as an efficient filling agent.

Schulten, Sudeck, Ringel, Korte, and Hellstrom have described operations which include the removal of portions of the scapula. In association with this they have utilized the remaining scapular muscles to aid in the filling of the empyema cavity. The

excision of portions of the scapula is inadvisable for two reasons: Cavities can be obliterated without it, and with it is associated marked limitation in the movements of the shoulder-joint.

Figures 11, 12, 13, 14, 15 illustrate the several steps in the operation which I have performed with satisfaction. The operation is designed to combine the effects of the

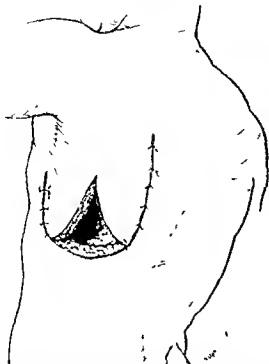


Fig. 15. Muscle implantation. Fifth step. U-shaped skin and fat flap has been restored. Triangular piece has been excised from border of flap to permit of free drainage, packing and stimulation of muscle granulations.



Fig. 16. 3. The infolding of two lateral flaps. Ribs, intercostal tissue and parietal pleura have been removed. Flaps sutured to lateral walls of cavity. Cavity exposed for packing and stimulation of granulations and epithelial growth. Cavity also accessible for skin grafting. B II illustrates incised T-shaped incision producing lateral flaps.

Schede type of osteoplasty with the aklal filling tendencies of muscle implantation. Reference has been made above to the unwillingness of the restored skin and muscle flap in the Schede operation to slump into the unroofed cavity. It tends rather to bridge it. In Fig. 14 the Schede flap is turned upward exposing the section of the latissimus dorsi muscle which forms its inner surface. The muscle has been split, one half has been sutured into the base and upper portion of the cavity, the other half remains *in situ* and will next be separated from the fat layer of the flap and likewise sutured to the floor of the cavity. If now the skin and fat flap should be stitched down in place it might again bridge as a tight membrane leaving a new space between it and the implanted muscle. This skin and fat flap then is divided vertically. A triangular piece of the flap is removed from the curved edge (Fig. 15). The U-shaped flap is thus converted into two lateral ones.

The newly incised edges can slump toward the depressed muscle to which they will again become adherent. Through the triangular wound the muscle surface and the unhealed lower portion of the cavity are accessible for cleaning, packing, and stimulation.

Let there be no misrepresentations regarding this method, it likewise has its limitations and discrepancies. The U-shaped flap even when cut to include a long tongue of the latissimus yet contains too little muscle to fill cavities of more than moderate size. In fact the muscle flap may be said never to completely fill, it merely occupies a greater portion of the cavity; there must be sufficient space around it for drainage of the temporarily persisting cavity secretions. From the nature of the discharge a few days after operation, it may be presumed that the buried tip of the flaps is nourished and partially sloughs. Nevertheless much has been accomplished in

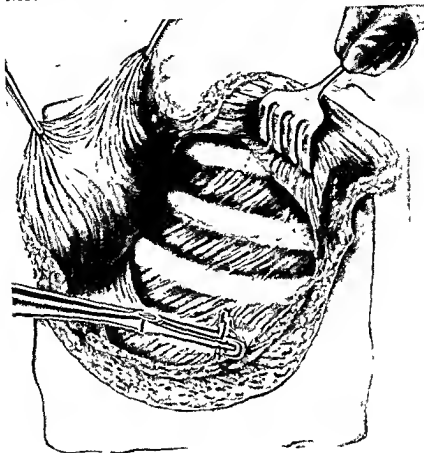


Fig. 17. Operation for obliteration of a chronic empyema cavity by the infolding of two lateral flaps produced by an inverted T shaped incision through skin, fat and muscle. First step. Cavity being unroofed by the subperiosteal resection of ribs.

filling and at least two new muscle surfaces have been provided which unlike the fibrosed pleura will generously granulate and further hasten the obliteration of the cavity.

Yet one more scheme of operative treatment I mention because of its particular usefulness in certain instances. It was suggested by the observation of a small empyema cavity—the persisting portion of a huge cavity which had been subjected to several obliterating operations of different types. The stitches of the skin flap had been removed prematurely after operation permitting retraction of the flap with complete exposure of the small cavity lying beneath. The pleural

lining was at first gray and slimy, the secretion abundant and purulent. It was a most convenient wound to dress, a small gauze packed into the cavity was self-retaining. Eventually the leathery, unhealthy pleural surface acquired a granular reddish covering.

Balsam of Peru was added as a stimulant to granulation. The epithelium of the skin bordering the edge of the cavity was rapidly replacing the new granulations, the cavity was being skin lined—not obliterated. A local depression in the chest was present but complete healing was prompt, the patient having been particularly free from evidences of absorption during his convalescence.



Fig. 18 (at left) Muscle implantation. Cavity of moderate size. Wound healed except over small granulating area representing remains of excised triangular segment of flaps (See Fig. 15).

Fig. 19. Operation by method of infolding lateral flaps

(See Figs. 16 and 17) Cavity exposed for stimulation and grafting.

Fig. 20. Large lateral cavity obliterated in seven months by three operations of Schede type. Note elevation of shoulder and lack of extreme deformity.

In two subsequent cases larger cavities were intentionally left entirely uncovered. One was at first doubtful as to the safety of such exposure. Again in each instance the gray pleura took on a thin growth of granulations which might even have been skin grafted in addition to the epithelialization of the borders.

From these observations an operation was performed on three later cases such as is described in Figs. 16 and 17. They were high anterior cavities in which the clavicle and first rib restricted shrinkage and obstructed filling. A vertical incision was made across the lower end of which a shorter curved cut was added. The wound was thus inverted T-shaped (Fig. 16B). The two lateral flaps were then dissected from the chest-wall. The entire cavity was then unroofed of ribs as in the Schede operation (Fig. 17). The lateral flaps were laid over the rib ends in the fashion of the pathologist who would protect his rubber gloves from lacerations during post mortem examination of the thorax. Interrupted silkworm sutures were placed to approximate the skin edges to the depths of the lateral walls.

It is quite obvious that the innumerable failures in the treatment of chronic empyema

are not attributable to a paucity of methods. They are more probably due to an inaccurate conception of the type of cavity to be obliterated in a given case, to the choice of some one method ill adapted to the obliteration of a particular cavity, to lack of pertinacious persistency in executing the several stages of the several methods.

The obliteration of a chronic empyema cavity is a problem in mechanics. The equipment of many surgeons consists solely in a knowledge of the technique of some one of the standard operations. Such is inadequate for the proper handling of these cases. A discriminate combination of the more effective features of several or all the types of surgical treatment, effects most often a cure. For example, given a cavity of the type illustrated in Fig. 2. The cavity is first carefully outlined with the aid of the probe, the barium-soaked bandage pack, and stereoscopic radiography. A decortication operation is planned and executed. In the fourth week of convalescence the cavity is again outlined. The lung is found to have retracted again not to its original position, but to a disappointing degree. Two months are properly allowed to elapse to permit the normal shrinkage of tissues and to restore the patient to suitable resistance. An

Estlander or Wilms operation is then made to flatten the convexity of the ribs and to further shrinkage. Three or four months later the cavity is shown to spread over a smaller thoracic area, it is narrower and deep only in its central portion. A local filling method is chosen—perhaps of the Schede type or the latter combined with a muscle implantation—or with a skin lining procedure. A due interval is again permitted after which the degree of obliteration is determined. The barium pack may now outline a tube-shaped cavity of not more than three or four ounce capacity (Fig 16). Such a cavity might

persist for months, it is, therefore, injected with Beck's paste. Sterilization of the space occurs, the skin closes; nature may then be expected to complete the obliteration without incident.

By such a sequence of therapy a large chronic empyema cavity may be cured within 12 or 14 months. No operation has been of a dangerous magnitude because a surgeon conversant in the methods at his disposal realizes the necessity of the several stage campaign, and willingly closes each stage at the moment which is consistent with the prompt recuperation of the patient.

A PRELIMINARY REPORT CONCERNING THE EFFECT OF FOREIGN SUBSTANCES IN THE PERITONEAL CAVITY¹

By WILLIAM R. CUBBINS, M.D., F.A.C.S., AND JOSEPH A. ABT, M.D., CHICAGO

WE were stimulated to undertake the study of the effect of foreign substances in the peritoneal cavity because so many different things are advocated as of value in the treatment of acute peritonitis and in the prevention of adhesions following operative manipulation or following acute inflammation of the peritoneum. As some of the agents advocated were violent irritants to most of the body tissues it was not quite clear to us why they should act as emollients to a membrane as delicate as the peritoneum. The substances so far used have been official tincture of iodine reduced to one half strength with 70 per cent alcohol sulphuric ether of the type used for anaesthesia commercial vaseline liquid alcohol white vaseline Russian mineral oil olive oil, almond oil lanolin. A great many of these substances have very similar actions which will be discussed later.

The first substance to be considered was iodine. The facts we aimed to determine with official tincture of iodine diluted to one half strength with 70 per cent alcohol were

1. Did it traumatize the peritoneum?
2. Did it inhibit the action of pathogenic bacteria in the peritoneal cavity?

3. Would adhesions be caused by its use?

It is very easy to determine by very delicate applications of the half strength tincture of iodine that it destroys the endothelium immediately and in conjunction with a moderate amount of trauma results in diffuse fibrous adhesions, as shown in illustration (Fig 3). Dogs averaging 20 pounds in weight were used in making these experiments. The animals were given one ounce each of the 3½ per cent tincture of iodine. They lived about eighteen hours, and at the post-mortem there was demonstrated a reddened granular peritoneum with 4 to 6 ounces of a brownish red fluid in the cavity. With each succeeding pair of dogs, two drams less of the mixture was used, and it was uniformly fatal until we used four drams of the mixture. About every other dog lived with this amount provided there had been no manipulation of the bowels accompanying the use of the 3½ per cent tincture of iodine, but they were all very sick for several days following the operation. Figure 3 shows one of the animals that died 70 hours after four drams of tincture of iodine had been placed in the cavity—without manipulation. Out of twenty animals, two lived about three

¹ Read before the Chicago Surgical Society, November 4, 1915. (For discussion see p. 631.)



Fig. 1. Four drams of a 3½ per cent solution of tincture of iodine was placed in the peritoneal cavity of a dog, after the bowels were manipulated with gauze and glove. The dog was killed in three months and the bowels were found matted together with firm fibrous adhesions.



Fig. 2. Four drams of a 3½ per cent solution of tincture of iodine was placed in the peritoneal cavity of a dog without manipulation. The dog was killed after three months. There were numerous adhesions formed.



Fig. 3. Four drams of a 3½ per cent solution of tincture of iodine was placed in the peritoneal cavity of a dog. Death followed in 70 hours from diffuse peritonitis. At post mortem there was found a thin red fish fluid which shows dark around the intestines. The intestines were firmly matted together.

months. The one with the trauma shows diffuse fibrous adhesions, which can be seen in Fig. 1, the other in which the iodine was simply poured into the belly and the abdominal wound closed shows firm fibrous bands between the loops of bowel (Fig. 2).

In addition to these experiments 4 drams of the 3½ per cent tincture of iodine was mixed with 1 dram of pus and allowed to stand for thirty minutes. It was then placed in the abdominal cavity of a dog. These animals died in 16 to 24 hours of diffuse general peritonitis. The iodine seemed to aid and abet the bacteria instead of inhibiting their growth. Five animals were treated in this manner, and the following conclusion concerning the use of iodine in dogs reached.

Iodine is an intense irritant to the peritoneum and favors rather than inhibits bacterial action. It will produce firm fibrous adhesions either with or without any manipulation of the peritoneum.



Fig 4 One ounce of ether was placed in the abdominal cavity without asepsis. The intestines were handled for one half minute. Death followed in seventy two hours from diffuse fibrinopurulent peritonitis.



Fig 5 One ounce of ether was mixed through the intestines with the finger. Death followed in ninety six hours from severe diffuse peritonitis of a hemorrhagic type, as shown in the picture.

The next substance experimented with was sulphuric ether for anaesthesia. The animals used in this series of experiments averaged about 15 pounds in weight. The facts we tried to determine from the use of sulphuric ether were:

1. What anaesthetic effect did it have?
2. Did it cause shock?
3. Did it have a post-operative analgesic effect?
4. Was it irritant to the peritoneum causing either fibrinous or fibrous adhesions?
5. Would ether inhibit virulent pus if mixed with pus before being placed in the cavity?

It was very easy to determine that one ounce of sulphuric ether in the peritoneal cavity of a 15-pound dog had an intense anaesthetic effect exactly similar to intravascular anaesthesia, that unless the animal was

allowed to waken before putting the ether into the belly, and the belly held open so that the ether vapor could escape, the animal would die from the anaesthetic effect within three to five minutes. The pouring of the ether into the belly of the semi-conscious animal as a rule caused the bowels to writhe and twist, and the temporary awakening of the animal with cries of pain was the common occurrence. This was followed by a deep anaesthesia, although there were variations in these two conditions, sometimes there being no irritant effect to the animal upon the application of the ether to the peritoneum, and in others there seeming to be very little anaesthetic effect.

As ether cannot be poured into the belly at a temperature above 88 degrees, when it is a vapor, at that temperature it is cold to the peritoneum and will produce a certain



Fig 6 One ounce of ether was placed in the peritoneal cavity under aseptic conditions. The dog was killed six weeks later. There were found fibrous adhesions of the bowels to each other and to the abdominal wall.

but variable degree of shock, the exact amount of which I have not determined. The rapid evaporation will also reduce the temperature of the bowel as can be shown by introducing a thermometer or the hand into the belly against the cold peritoneum. If the cavity is not closed within seven minutes no ether remains as it evaporates very rapidly. It was nothing unusual during the evaporation to have a loop of bowel or the omentum extruded from the wound by pressure of the ether vapor before the wound could be closed.

There was no analgesic noticeable following the experiment, as the animal seemed to be far more restless and uncomfortable than the other experimental animals, but that is a question of judgment which is capable of wide variation.

The local effect on the peritoneum was not dissimilar from that of handling or exposure

to air. It is not nearly so violent an irritant as 3½ per cent tincture of iodine. When the peritoneum is manipulated with the gloved hands and gauze sponges and ether applied, there is not much more trauma than one would expect with manipulation alone; but the ether did seem to have a very marked effect in reducing the resistance of the peritoneum to infection.

In Figs 4 and 5 we see the effects of handling the intestines under conditions which were not clean, and then putting ether into the belly. These animals died, one in 72 and the other in 96 hours, and each shows violent peritonitis. Figure 4 shows a fibrinopurulent condition with pus down in the right side of the belly, which gives a highly refractile edge. Figure 5 shows a diffuse fibrinous peritonitis of a hemorrhagic type.

These two experiments are examples of about 25 experiments under relatively similar conditions, in which we were endeavoring to



Fig 7 One ounce of ether was poured into the abdominal cavity, under aseptic conditions. The dog was killed three months later, and fine fibrous adhesions were found between the loops of intestine.

determine if ether would have an inhibitive effect upon any infection introduced into the peritoneal cavity, but these experiments have shown that any carelessness in asepsis with ether brings on a fatal result in from 24 to 92 hours. Not one of our animals survived if the placing of the ether in the peritoneal cavity had been accompanied by unclean manipulations of the bowels. This was also true where ether was mixed with pus and allowed to stand one half hour previous to its being placed in the peritoneal cavity. In the aseptic operations in which ether was placed in the peritoneal cavity, the animal stood it much better, about every other one living. When the ether was placed in the belly, after the intestines had been manipulated with the gloved hands from thirty seconds to one minute, adhesions followed of the type illustrated in Fig 6. It will be noted that



Fig 9 The intestines of a dog which was killed three months after two ounces of vaseline was placed in the abdominal cavity. The bowels were firmly matted together with fibrous adhesions and pockets of vaseline were found between the loops. There was very little, if any absorption.

there are firm fibrous adhesions uniting a loop of bowel to the mesentery of another bowel.

In Fig 7, we see the result that ether will produce where it is poured into the belly without manipulations of any kind. However, the result shown in Fig 7 is not always present. In about one half of the number of cases in which ether was put into the belly without manipulation and the animal recovered there were no adhesions or any marks of trauma of any kind. However, it is well to state here that we had a mortality very close to 40 per cent after putting ether into the belly without any manipulations, and that half of the number of dogs which survived had adhesions, and half did not. These adhesions were always of a fine hair-like type, as shown in the illustration.

From these experiments we cannot see the value of the use of ether in the peritoneal



Fig 8 The dog was killed eight days after two ounces of sterile vaseline had been placed in the abdominal cavity. The bowels were found to be matted together and in the lower portion of the cavity there was a reddish fluid with lumps of vaseline.



Fig 10 Four ounces of paraffin oil was placed in the abdominal cavity, and there was no absorption at the end of six weeks. There were firm adhesions at site of the abdominal wound.



Fig 11 In this dog paraffin oil was inserted without trauma. The paraffin caked on the spleen but there were no adhesions.

cavity, and it is our candid opinion that individuals in whom it is used will recover in spite of it and not because of it.

The next substance with which we experimented was ordinary yellow commercial vaseline. Vaseline has gained considerable reputation as an emollient for its favorable action upon the endothelium of blood vessels and the non irritating qualities that it has upon granulation tissues of burns or abrasions. We have conducted nine experiments using vaseline in the abdominal cavity and endeavored to determine four things:

1. Was it an irritant?
2. Was it absorbed?
3. Did it prevent infection?
4. Did it tend to prevent adhesions?

In each case in which vaseline was put into the belly of an animal, the animal was violently sick. Two animals died in about 48 hours of intussusception of the bowels. The peritoneum was reddened, swollen, and in-

flamed throughout. There was free and bloody fluid in the peritoneal cavity, the peritoneal cavity appearing very much as is shown in Fig 8, of an animal that was killed on the eighth day. Here the bloody fluid is shown as a dark area in the lower part of the belly with the highly refractile lumps of vaseline lying in the center of the fluid. One dog, which lived three months and was killed, shows the matting together of the bowels with firm fibrous adhesions, with pockets of vaseline in between each loop of bowel (see Fig 9).

From these experiments we conclude that vaseline is an intense irritant to the normal peritoneum of a dog, and that it is absorbed very slowly, if at all. We have had two cases of vaseline in the peritoneal cavity of humans, in which it was necessary to open the belly and allow the vaseline to escape practically in the same condition as it was when it had been put in three and four months



Fig 12 The loops of bowels were traumatized, and then a thin layer of paraffin oil was put over the area of trauma. Firm adhesions formed between the loops.



Fig 13 Dog killed six weeks after two ounces of paraffin oil and a sponge had been placed in the abdominal cavity. The sponge was found on post mortem to be surrounded by firm fibrous adhesions and was lying in a lake of yellowish looking fluid.

before. The walling off of the vaseline in the belly of these two humans was just as firm as if it had been around an abscess.

I did not mix vaseline with an infection of any kind as it seemed to be deadly enough when used in any quantity at all without the increased danger of an infection.

White vaseline, albolene, and lanolin all seemed to have a very similar irritating effect.

The next group of experiments were conducted with Russian mineral oil, which was imported before the outbreak of hostilities. The facts we wished to determine with this oil were

- 1 Did it irritate?
- 2 Was it absorbed?
- 3 Would it cause adhesions?
- 4 Would it prevent adhesions?

This substance was used in the bellies of 16 animals and it did not seem to have an irritant effect in any one of the experiments.

Figure 10 is the picture of an animal in which we put 4 ounces of paraffin oil under

aseptic conditions. At the end of 6 weeks, the oil is present in practically the same quantity that it was put in, and in no places was the peritoneum reddened, inflamed, or irritated in any way. There were firm, fibrous adhesions to the abdominal wound.

In Fig 11 we see the effects of a smaller amount of oil. Here it cakes on the spleen as a white mass, while the peritoneum beneath it is perfectly normal.

In Fig 12 can be seen a loop of duodenum firmly adherent to jejunum. These two loops of bowel had been handled with the gloved hands for about thirty seconds. They were then smeared with paraffin oil, after which one ounce of paraffin oil was placed in the abdominal cavity. While there is no free oil in the cavity, the use of the oil did not prevent firm fibrous adhesions. We then took a gauze sponge soaked in sterile paraffin oil, and placed it in the belly with about one ounce of paraffin oil in addition to that which was in



Fig 14 Two ounces of olive oil was placed in the peritoneal cavity, without trauma. After six weeks the oil is seen as a milky fluid on the spleen



Fig 15 Olive oil was smeared as a thin layer over the peritoneum after handling for one minute. The dog was killed in three months. There were few fibrous adhesions.



Fig 16 Two ounces of olive oil was placed in the peritoneal cavity after trauma. Twenty-two days after operation there were firm fibrous adhesions.

the sponge. This was done under aseptic conditions. The animal was killed at the end of six weeks and the sponge was surrounded by firm fibrous adhesions, and lay in a lake of yellowish looking fluid. This can be seen in Fig 13. We did not try to use the paraffin oil with infection, so that we cannot say whether it will, or will not, prevent a peritonitis.

The things that we were able to determine were that paraffin oil is relatively non-absorbable, and that it will not prevent adhesions, although it is far less irritating to the peritoneum than vaseline.

We next experimented with the olive oil and endeavored to learn

1. Was it an irritant?
2. Was it absorbed?

3. What was its action with trauma in the peritoneal cavity, and what was its action without trauma?

Olive oil in the free peritoneal cavity without trauma, is non-irritating and slowly absorbed. In Fig 14 we see the milky white oil through the peritoneal cavity six weeks after one ounce had been put in under aseptic

conditions, as is shown by the white droplets on the spleen. A similar condition was found in the rest of the abdominal cavity, but it does not show as distinctly as it does on the spleen. There were no adhesions, except to the abdominal wound, where it had no effect on the production of firm, fibrous adhesions.

Figure 16 is an illustration 22 days post-operative of the effect of trauma with olive oil smeared over the traumatized area, and one ounce of olive oil placed in the peritoneal cavity in addition. There were firm, fibrinous adhesions between these loops of bowel, and the oil was still present, some of which can be seen, as a white mass, on the edge of the liver at the upper angle of the wound.

In Fig 15 are some fibrous adhesions between two loops of bowel, which were manipulated for 30 seconds with the gloved hands smeared with olive oil, after which one ounce

of olive oil was put into the peritoneal cavity. There are a few fibrous adhesions between these loops of bowel; but there is no free oil in the peritoneal cavity, as we saw in the other experiments of 22 and 42 days each.

Olive oil seems to have very little, if any, irritating effect upon the peritoneal cavity. In only two of the animals experimented upon, in which trauma was used and olive oil used as a preventative to adhesions, did adhesions fail to form. In other words, in about 20 per cent of the cases, adhesions did not form when olive oil was used, but they did form in 80 per cent.

From these experiments I would conclude that olive oil has little, if any, value in preventing adhesions, although it has little or no irritating effect upon the peritoneum.

We are making another series of experiments with different fats, oils, and blood, which will be reported at a later period.

PSYCHIATRY AND GYNECOLOGY¹

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I. INTRODUCTION

DURING the past several decades the relations which disease or dysfunction of the female generative organs may bear to mental disorders have been subjected to much observation, research, and discussion, by both gynecologists and psychiatrists. The charge has been made (1) that there has been too little teamwork between the followers of these two specialties and that, therefore, extremists have advanced their antipodally variant views, the mid-ground of common belief having been neglected. If this is true, it would appear to have been a wise thought which has led to this joint meeting of our two societies here on this occasion for an interchange of viewpoint and experience.

It is some thirty years since Battey in this country recommended the castration of females as a cure for their mental disorder.

For some years following this therapeutic suggestion men performed many useless, and, it may be said, even harmful mutilations of the female genital organs. Some years later Rohé (2) and Hobbs (3, 4) published the results of their observations along this line and the latter says "The results following operative treatment have exceeded expectations. Not only have the majority of the cases treated been restored to physical health but as a sequence, in a large percentage, their mental condition has been brought up to par." Rohé states: "That derangements of function or structural alterations in extracranial organs may reflexly irritate or depress the cortical functions I venture to believe," and Hobbs further states "those organs concerned in the reproduction of the species are more closely related to the great nerve-centers than any other part of the organism." Such were

¹ Read at the joint meeting of the Gynecological Section of the St. Louis Medical Society and the Neurological Society of St. Louis, October 19, 1911.

the tenets of belief which served as the fundamental basis upon which Rohé and Hobbs conducted their work. Among others who supported and still do support such contentions was Schultze (5). Russell (6) criticized severely the work of Rohé and Hobbs and brought forth a group of collected opinions to substantiate his objections. Mantou (7) went so far as to state that: "In not a single asylum case could insanity be traced solely to abdominopelvic disease" nor could a single cure of mental disease be attributed to the effect of an operation alone. More recently a most ardent advocate of the belief that almost all human ills in the female, and particularly mental, are caused by gynecological disorders has appeared in Italy in the person of the gynecologist Bossi (8) of Genoa. For some years past Bossi has fanned into a flame a most active propaganda, not only among the medical profession but even among the laity, his photograph and creed appearing recently even in the magazine section of our own Sunday newspapers. We all know how common, too common indeed, is the belief that pelvic disorders are the chief cause of insanity among women. At least a partial explanation for this belief may be found in the observation made since the beginning of medical history that psychoses appear to develop more frequently in women at puberty and the menopause, and that in normal women psychic disorders do sometimes become apparent in association with the menstrual period and pregnancy.

Most psychiatrists cannot see in gynecological disease or disorders the enormous etiologic agents which some gynecologists have claimed. More recently indeed, most gynecologists have adopted a more conservative attitude as shown in the paper of Taussig. With occasional exceptions, all are more of the opinion now that "there is, however, no mysterious or specific connection between the genital organs and the central nervous system. There is, on the other hand, between the two exactly the same relationship that exists between the brain and every other area of the body and the laws of pathological action and reaction are exactly the same" (1).

After this somewhat general survey of the subject we will now undertake a more detailed consideration of its individual phases. What I will have to say will relate primarily to the true psychoses alone. Except for occasional mention, what are commonly known as "nervous diseases" will not be considered, as such will be the subject of another contribution to this program.

II. THE THEORIES OF MECHANISMS OF THE RELATIONSHIP OF GENITAL DISEASE OR DISORDER TO THE PSYCHOSES

A. THE CO-ORDINATE, SUPERORDINATE, OR SUBORDINATE CHARACTER OF THIS RELATIONSHIP

The relationship of genital to mental disorder may be threefold: the genital disease or disorder may be co-ordinate, superordinate, or subordinate considered in reference to the psychotic manifestations where these present themselves. There is hardly any question raised concerning their co-ordinate or coincidental occurrence in a given individual. Genital disease is negligibly more frequent in insane than mentally normal women. It is not questioned but that in many instances the occurrence of genital disease in insane women is merely incidental and in no wise causal. At the same time, it should be mentioned that an accurate evaluation of the elements of cause and effect has not been made always where disease in these two systems has been found coexistent. Hence the difficulty in determining this question of superordination and subordination has arisen. Possibly gynecologists are more inclined to look upon the genital disorder as superordinate while psychiatrists are wont to place it in a more subordinate position. Of course, we do not mean to infer by this statement that we believe a mental disorder can be the cause of a tumor or malposition. Reference is made rather to functional disorders, such for instance, as a disturbed menstruation. For example, in the absence of organic disease of the genital organs, when amenorrhœa occurs in conjunction with psychosis, are we to suppose the amenorrhœa is caused by the psychosis, or the reverse, or either? We shall have occasion to return to this later.

B. THE THEORY OF REFLEX ACTION

To proceed with the theories of the mechanisms of relationship which have been claimed to exist between mental and genital dysfunctions, the first which we will consider is at the same time the oldest—the reflex action of the genital organs, and particularly in diseased states, upon the nervous system. Pinel has stated (9) that the primary seat of mental alienation is generally situated in the region of the stomach and intestines and that from such center the disease propagates itself, as it were, by irradiation, and deranges the understanding. Rohé clearly states his belief in this theory when he says "that derangements of function or structural alterations in extracranial organs may reflexly irritate or depress the cortical functions . . ." In some instances (10), no doubt, the use of the term reflex was intended to convey the meaning of an intoxication or similar process depending upon the local disease, i.e., reflex meant indirect. However, it would appear that not too infrequently reflex was used in the manner of Pinel and meant about the same as idiopathic does to us; unknown. At all events, it appears today that any such use of the term reflex is but a useless cover for speculation and in fact it has largely disappeared and has been supplanted by more modern conceptions which we shall mention in greater detail under the next three headings.

C. THE THEORY OF PSYCHOGENIC ACTION

The rôle of psychogenic factors in the production of a certain class of functional psychoses has been more closely investigated and emphasized in recent years than formerly was the case. Faulty mental mechanisms working upon hyperquantivalent ideational constellations are seen not infrequently to lead to the development of a true psychosis. More frequently, perhaps, neuroses owe their existence to such origins. Walthard (11) particularly has called attention to what he has termed the "genital psychoneuroses" and emphasizes the fact that in these the pathological mental habit is primary, that is to say sensations referable to the genital organs are perceived and an

overvaluation of their significance is placed upon them. Carstens (12) and Dercum (13) also have pointed this out. The causation here may be purely psychic, ideational, for as Walthard points out, such conditions are equally frequently found in women with sound, diseased, or removed pelvic organs. As the psychogenic factor is probably more prevalent in the production of psychoneuroses than psychoses we will leave this without further comment at this time.

The last two possibilities—toxic and endocrinic—are the most important in our discussion. They are the more prevalent and are receiving the greatest attention at the hands of gynecologists and psychiatrists at the present time, perhaps it may be, more by the former than the latter.

D. THE THEORY OF INTOXICATION

The possibility of the causation of mental disorders by intoxications arising from diseased conditions of the genital organs brings us to the particular consideration of the work of Bossi as he is no doubt the most ardent advocate of this theory as well as one of the most recent writers in this field. According to Bossi it is not carcinoma, myoma, or other serious organic disease which bring about the intoxication but rather the more benign conditions, such as endometritis, cervical lacerations and erosions, menstrual disorders, malpositions, etc. It is no new idea that such minor local conditions might be the cause of mental disorder. Griesinger (14) called attention to the frequency of hysteria attributable to such anomalies. Kraepelin (15) likewise notes the same but qualifies his statement by adding that such diseases of the female genital organs only cause psychoses when a constitutional predisposition to mental disorder forms the soil. Prichard refers particularly to psychoses caused by menstrual disorders. However, Bossi is more explicit in stating the mechanisms by which such disorders cause psychoses. To him psychoses are the expression of cerebral intoxication from the genital apparatus. The menstrual discharge is a purification and, therefore, in amenorrhea there is a retention of toxic matter. Also,

infectious endometritis produces cerebral anemia or congestion. There has been no proof of the toxic character of menstrual discharge and we know entirely too little of cerebral anemia and congestion to speculate upon such changes in vascular supply as the causes of psychoses. To understand by just what physiologic process such local disorders in the genital apparatus can bring about such toxic or vascular disturbances intracranially is, to say the least, difficult. Furthermore, assuming that such conditions were thus occasioned, why is it, may one ask, that disease in other viscera, such as the heart or liver, does not occasion similar disturbances in cerebral vascular supply? Or, if it does, and this is not an unreasonable assumption, why are psychoses due to such conditions so infrequent? Why do not infections in other organs or parts of the body exert more frequently a toxic etiologic influence in the production of psychotic disorders? To be sure, we do meet with psychoses which we attribute to disease of other organs than the brain, such as the deliria depending upon general infections, as typhoid or influenza, psychotic states associated with nephritis, cardiac disease and the like. Also, we must recall here the psychoses which develop in relation to infection or exhaustion incident to the puerperium. All of these are fully recognized and properly spoken of under the collective term, "symptomatic psychoses" (16). But in these we have some semblance of a logical connection between cause and effect. Furthermore, they constitute but a small percentage of the total number of psychoses met with, whereas Bossi would attribute practically all psychoses in women to gynecological disorders. The severe and carefully analytic criticism (20, 37) to which Bossi's work has been submitted, both by gynecologists and psychiatrists, makes it unnecessary to go into further detail at this stage.

2. THE THEORY OF ENDOCRINIC GLAND ACTION

"It must be evident to everyone that there reigns the greatest confusion in the subject of the functions of the glands of internal secretion" (17, 18). Any yet, when we read the papers written by some of our gynecolo-

logical concretes, especially those of W. Blair Bell (19), how comparatively simple all appears to be. It used to be thought that a woman was a woman because of her ovaries alone while now it is said (19) that the potentiality to produce femininity "is directed toward the future development and correlations of the endocrinous glands which are to control the sexual evolution of the individual. From a disturbance due to disorders in but a single gland (ovary) we have substituted the theory in its pluriglandular aspect. It is true that "much evidence has been accumulated to show that diseases of the ductless glands are usually plural rather than isolated and single" and that "there are two forms of endocrine disorders—organic and functional" of which, fortunately, the former are rare (20).

Among some of the statements made by Bell concerning the rôle of certain endocrine glands in the production of disorders in function and the treatment which is, according to him, physiologically indicated, the following are interesting examples. The hyperfunction of the ovaries and thyroid (but which causes the other is speculative) produces menorrhagia. The treatment is, therefore, simple; counterbalance these hyperactivities physiologically by giving extract of pituitary and adrenal and perhaps add a little calcium lactate. In another place he states that the pubescent psychoses (21) are often due to disorders of menstruation; there is too little or too much flow. He would give pituitary for the latter and thyroid for the former. We learn that hystero-epilepsy is due to the depletion of lime salts from the tissues, ergo, calcium lactate and pituitary are indicated. Also, that the psychoses which occur at the menopause are often greatly relieved by thyroid, or in cases where this is not efficient one may try pituitary plus ovary. In the psychoses which occur during pregnancy and parturition thyroid may be given with the greatest benefit. It is not the place, nor does space permit us, to comment upon the ideas expressed in the foregoing paragraph.

Bossi has not yet arrived at the pluriglandular stage of development in his theories.

Therefore, simplicity, superficially at least, is evident in his statements regarding the internal secretion of the ovaries. A hyperactivity causes states of mania while a hyposecretion leads to melancholic conditions of mind. He appears to forget that we have definitely known and recognized mixed states, especially in manic depressive insanity. And how are these to be explained by internal secretory disorders of the ovary? Are we to suppose that the secretory activity varies from one moment to another or that one ovary exhibits hyperfunction while the other is putting out less than normal secretory products? Is there in reality any basis in fact for the belief that ovarian dysfunctions can act to produce true psychoses? The recent study by Gordon leads to the conclusion that there is none. Others (21) likewise conclude that such psychoses as develop at puberty and menopause (natural or by castration) do not have their cause in the disturbance in the sexual gland activity but that these life epochs are but accessory moments acting upon a labile brain. Of the cases studied by Taussig a proportionately small number (10 per cent) developed psychoses at the time of puberty or menopause. As Hyslop (22) says "The rôle of the internal secretions in their causal, coincidental, and sequential relationships to mental disorders has already received a considerable amount of attention," and as yet the balance of opinion is against the belief that disturbance of the internal secretion of the ovary can be the direct cause of any of the true psychoses. That disorders in some members of the endocrine system do produce marked and evident changes in mental states we cannot deny. It is only necessary to recall to mind the picture of the active, excitable, restless mental state associated with hyperthyroidism and the opposite phase as seen in cretinism and myxœdema. But we are unable to point to any such definite condition wherein only the ovaries are involved nor by the mental symptoms alone are we able to predicate an increase or decrease in ovarian internal secretory activity. That the glands directly associated with the generative system may

play some part in relation to certain psychoses may be true, but in what way this may be we are not in a position to state at present. One suggestion is that these two systems, the generative and the nervous, may best be considered for the time being as reciprocally stimulating. Also, another viewpoint which must not be clouded is that these glands may act more indirectly than we are aware. For instance, this action may be by the production of some change in the body metabolism which in itself secondarily leads to the appearance of mental disorder.

It would not be proper to leave this section without a brief mention of the support which may be offered the endocrine theory of the causation of mental disorders by the results of the study of mental diseases by Abderhalden's method (23). It is no new idea that dementia præcox in some way is dependent upon some disturbance within the realm of the genital glands. It has been thought, for instance, that disorder in these glands lead to disturbances in general metabolism, especially in reference to certain inorganic salts. It is, perhaps, a striking observation that in dementia præcox dialyzation against genital glands (ovaries or testes) has given, in the hands of some, a wonderfully high percentage of positive returns. It is assumed that this indicates some kind of destruction of the constituents of the glands in question, the products of which, reaching the blood, may be recognized by this technique in the serum.

But, on the other hand, when we come to look at the mental diagnoses made by those who have favored the idea of the genital origin of mental disease we are confronted with a large proportion of the acute insanities, and especially is manic depressive psychosis mentioned as among the most frequently met with (24, 25). And yet with the Abderhalden test it is the manic depressives which give practically always negative findings. To be sure, it is realized that the Abderhalden test cannot, in so far as the pathogenesis of the psychoses is concerned, be looked upon as of final value. Yet, if any such speculative support is to be brought forward it will be found to aid the belief that the genital glands or their internal secretions,

or disorders of either, are not as yet shown to be a direct cause of mental disease.

III DATA OF OBSERVATION AND RESEARCH OFFERED IN SUPPORT OF THE THEORIES ABOVE DISCUSSED

A STATISTICAL DATA

1 *Ratio of female to male insane* If gynecological disorders play such an exclusive rôle in the production of mental disease as Bossi would have us believe, or even a lesser rôle as other supporters are inclined to claim, what effect might we expect this to have on the relative number of male and female insane? If we refer to some of the older data (26) we find varying statistics given by different writers for different countries, these variations probably largely to be explained by the inaccurate collection of information. If we refer to the last census of the United States (and in this a special attempt toward accuracy regarding the insane was made) we find that insane males are in the majority (27). They are also in the majority in the total population of the United States but not to so marked a degree. In the total population there are 106 males to 100 females, in the institutions for the insane the ratio is 110.8 to 100, and among the admissions to such institutions it is still higher, being 128 to 100. In proportion to the total population the males admitted during the year 1910 represented a ratio of 72.1 per 100,000 and the females a ratio of 59.7 per 100,000. Another interesting point brought out is that in no age period is the ratio of admissions as high for females as it is for males. That is, even the supposed influence of the climacteric toward the production of psychoses is not here sufficient to produce more insanity in females than males of similar age groups. It is interesting to note, that in 1910 Missouri was one of only four states in which the ratio of admissions was higher for females than for males, although in proportion to population there were more male than female insane in institutions on the first day of that year. From these statistics, the conclusion seems justified that women, because such, are not only not more

prone to the development of mental disease than are men but to the contrary less so.

2. *Frequency of gynecological disorder in sane and insane females.* 3. *Character of gynecological disorder in the insane.* If genital disorder is to be considered a prime etiologic agent in the production of insanity in females would we not expect to find it more frequently present in the insane than the sane woman? The question first arises as to what shall be considered a gynecological disorder in this connection—a question which we must leave to the gynecologist himself. Apparently there is some difference of opinion on this point. Bossi would have every insane woman and half of the female suicides gynecologically abnormal in some respect. Hobbs found pelvic disease in 93 of 100 insane women examined. Rohé found that "systematic observations seem to show that insane women do suffer in larger proportion from pelvic disease than sane women do," 60 per cent in his cases, though not always requiring treatment. Topler (28) found 50 per cent of women with mental symptoms at the menopause had gynecologically normal pelvic conditions. Tausig says 47 per cent of insane women are abnormal gynecologically, only slightly more than not insane women. Koenig and Lunzenmeier (29) give 35.9 per cent gynecologically abnormal in their series and further state that 50 per cent of these were found in the psychoneuroses. Bumke (30) found the gynecological condition to be the same in normal as in insane women. It would appear, therefore, that gynecologists who have interested themselves in this work in recent years are fairly uniform in the opinion that, comparing sane with insane women there is no great difference in the incidence of gynecological disease or disorder. And moreover, the opinion is practically unanimous that it is the milder, more benign types of gynecological trouble which are met with in insane women and not the more serious and severe organic diseases.

4. *Result of gynecological treatment determined by the number of mental recoveries and improvements.* What has been the effect of the introduction into insane hospitals of the gynecological procedures as shown by the

cure of the mental disease? One of the most obvious ways to determine this would appear to be by a study of any change in the discharge rate of insane females after the introduction of gynecological procedure as compared with the rate before that time. This method has been resorted to by many. It has been claimed that the recovery rate as a result of gynecological treatment, including here the improved cases, has ranged from 50 to 60 per cent. Hobbs states that, for a period of five years after the introduction of gynecological treatment, discharges increased in women by 35 per cent. It has been pointed out (31), however, that, contrary to these older experiences, the records of various large hospitals for the insane do not show any such increase in the discharge rate of females following the rather general introduction of gynecological treatment in such hospitals.

A more important factor in the consideration of this phase of the subject depends upon what the type of the psychoses is and what are to be the criteria of cure. In all papers on this subject appearing prior to the last two decades the question of the diagnosis has been one of difficulty. By many, if not most, observers symptoms of mental disorder have been accorded the dignity of a diagnosis. Thus we find such diagnoses as acute, chronic, and epileptic mania, acute melancholia (Hobbs), puerperal insanity, hysterical mania (Rohé), suicidal mania (Bossi) and similar terms. It was not recognized that an excitement or depression might occur as the most manifest symptom of a mental disorder which might in turn rest upon either a functional or organic basis. More recently Gibson has recognized the advisability of separating certain organic from the functional psychoses and, therefore, divides mental diseases into two groups. The first, psychoses with dementia, such as dementia præcox, paresis, epilepsy and senile dementia. The second, without dementia, including manic depressive insanity and allied forms and "paranoiac conditions." His observations accorded with his expectation that in the first group he would find no improvement in the mental condition as a result of gynecological treatment. He

agrees with the conclusion of Taussig regarding the relation of gynecological disorder to manic depressive insanity as follows: There is a greater frequency of such disorders in cases of this mental type than is true with other psychoses, and especially is the large proportion of chronic infective conditions of the genital organs prominent. Also, the proportionately large percentage of mental recoveries after gynecological operations in the manic depressives is taken as significant. Taussig found gynecological disorders of one kind or another in seventy-four per cent of his manic depressive cases and quoted Broun as reporting 70 per cent of recoveries after operation in these cases thus supporting his somewhat similar experience. It is certainly significant to note that in those cases more uniformly recognized to have benefited from gynecological treatment, in so far as can be ascertained from the diagnoses at least, we have to deal with the more acute mental disorders or with the more manifestly acute symptomatic expression of these, in either instance, more or less self-limited outgrowths of psychic instability. This statement applies equally well to the older and more recent contributions to this subject.

What are we to consider a mental cure or improvement? What causal relation, if any, does the gynecological treatment bear to the change which may coincidentally occur in the mental state? If the acute mental state symptomatic of an underlying dementia præcox, paresis, or cerebral arteriosclerosis is replaced by a condition of quiet and dullness incident to an advancing dementia we are hardly justified in counting this as an improvement and less so as a cure. Possibly from the custodial viewpoint it may be an improvement but most emphatically and certainly neither an improvement nor a cure from the prognostic side. We have ceased speaking of psychoses developing during the puerperium as entities under the term puerperal psychoses. But even if, for the moment's convenience, we retain this term with its older meaning, it is not surprising that the treatment directed at the local condition would be of benefit to the individual as a whole. It is common medical

practice to attack infection at its seat and as Carstens says (perhaps with some exaggeration), "Puerperal insanity is puerperal infection in 90 per cent of the cases." We treat other psychoses resulting from infection by drainage of the focus and why should wonder be aroused when the puerperal uterus, being the locus of infection, is treated in a similar manner with good results? Is not such an attitude uncritical and dependent upon a narrowed or prejudiced viewpoint? In commenting upon the large percentage of recoveries in manic depressive insanity following gynecological treatment does not the gynecologist lose sight of the fact that this is the recoverable psychosis *par excellence*? And in marking these recoveries down to the credit of repaired gynecological conditions is not the time relation as well as the natural tendency of the psychosis to recovery overlooked? We must remember that we have manic depressive patients who have repeated recurrent attacks throughout life. Moreover, such attacks are often similar in symptomatology and duration, and in the interval between them the mental state is normal in so far as we are able to determine. Suppose we take a case in which previous attacks have averaged four or five months in duration, which is about the average of all cases. Now, if after a given attack has been present for three months, suppose a month or so following a gynecological treatment recovery takes place mentally. Are we not stretching our statistics when we record this recovery to the credit of the local treatment alone? Or again, in so-called hysterical psychoses, where reputed recovery takes place within a day or so after a gynecological operation, can it possibly be that it was due to changes in the genital organs wrought by operation? Is it not logical and more nearly in accord with experience to attribute such recovery to the psychic state induced indirectly by the operation or even by the thought of it? I have seen, in a case of simulated brain trauma a hysterical hemiplegia disappear following general narcosis, scalp incision, and elaborate dressing. Others (32) have reported similar good results following simulated operation on the genital organs. It is particularly

among the unstable psychoneurotics that such suggestive therapy is efficient. It is one of the most salient criticisms of Bossi's work that all but five of his forty some cases of what he diagnosed as *Wahsinn* were instances of psychoneuroses and not true psychoses and that the cure was largely, if not entirely, due to the psychic state engendered in the patient by suggestion. From the psychiatric standpoint the work of Bossi is quite worthless and his conception of the psychoses is comparable to that of the layman. Bossi has also been quite severely criticised in regard to some of his gynecological conceptions. This is especially true with regard to his assertions as to the great frequency of septic endometritis and in connection with certain of his methods of treatment. In reference to the former Carstens says, "such cases must certainly be rare."

B. PROOF OFFERED TO SUPPORT THE TONIC AND ENDOCRINIC THEORIES

In as much as Bossi has been such an ardent supporter of the toxic theory it will not be amiss to mention briefly the means by which he claims to have arrived at the conclusion that this mechanism is a most important one in the causation of mental disorder. In the first place Bossi believes that in amenorrhœa the retained menstrual discharge acts as the toxin. This is his most direct statement of belief. Regarding the manner by which other genital disorders may result in the production of a toxic agent which in turn affects the central nervous system he is somewhat more vague. Of his attempts to demonstrate the toxicity of uterine and vaginal secretions by animal experimentation we will make but the briefest comment. It would appear from the criticism of this work that his conceptions of the technique essential to prevent contamination while obtaining such secretions, of the controls of methods of animal experimentation and of bacteriology in general, were no more developed than his knowledge of psychiatry. It will avail us little to go further in our remarks concerning the conclusions of this writer. Such comment as has been made

appeared almost necessary because of the ultra-extravagant claims which their originator has made for the results which he asserts he has obtained

As to the observations which have been made to support the theory that mental disease does result from a disturbance in the structure and function of the sexual glands of internal secretion there is much of a speculative nature which might be said. In the first place, we know too little of definite nature of the physiological action of such internal secretions. Most of our knowledge has been derived by experimental therapeutics, by analogy from the result of animal experimentation and from the study of individuals in whom these glands have been diseased or removed. There is actually very little knowledge of fact regarding the subject, not sufficient at least to permit a claim that a disturbance of these secretions is the direct cause of a mental disease. By most observers this situation is fully recognized and we meet with more frequent expression of the opinion today that the sexual glands do not act independently, that we must consider more fully what effect a disturbance in sexual gland secretions would have on the endocrine system in general and what the consequent effect of such a systemic disturbance on the nervous system would be. That disturbance of function in certain of the ductless glands may act as the fundamental cause in the production of psychic anomalies, there can no longer be any doubt. To such a possibility we have already referred in the case of the thyroid and pituitary and there is some evidence to show (33) that defective mental growth may possibly be dependent upon disorders in the pineal body. Facts have not demonstrated that other mental diseases are resultant from disorder in the ovaries or its internal secretion and analogy does not justify the assumption that such may be the case.

It is admitted (19) that ovarian insufficiency is a difficult condition to diagnose and yet we are in a position to observe the effect of such hypofunction perhaps more easily than is the case with almost any other glands. Removal of these glands has been,

especially some years ago, a very common procedure. Not only was oophorectomy performed because of malignant and similar diseased conditions but even entirely normal ovaries were frequently removed as a remedy for mental disease. What the results have been from such operations we all know—so far as the mental condition is concerned; no improvement and perhaps some aggravation. Possibly, in part from our knowledge of the effect of total ablation of certain other endocrine glands, we have come to recognize that it is unwise to remove all ovarian tissue unless disease makes this imperative. The previously mentioned study by Gordon (34) on the effect of complete oophorectomy in women led to the conclusion that, although a total removal of these glands was often followed by the appearance of a train of nervous symptoms, in no instance was a true psychosis thus occasioned. It is of passing interest to comment upon the fact that, whereas not many years ago a removal of the ovaries was recommended to cure a psychosis, today there is a strong tendency to believe that functional insufficiency on the part of these glands causes mental disorder. What was once a cure has now become a cause. This alone tends to show how little we really have known (or know?) concerning the part played by these organs.

C MENSTRUAL FUNCTION AND PSYCHOSES

In speaking of ovarian insufficiency or hyperactivity, mention of various menstrual disorders is not uncommon. Likewise is the very trite belief that menstrual disturbances and mental disease are closely associated in relation of cause and effect very generally expressed. The question arises at once, are the menstrual disturbances, other than those which owe their origin to known organic genital disease, dependent upon the deranged ovarian function, and if so, is a coincident mental disorder to be referred to the former or to the latter? Or may both of these be explained by the removal of the integrative action of the brain through the agency of an existent mental disease? The enormous potential to produce disturbances within the central nervous system attributed

to anomalies in menstruation appears to have been somewhat overestimated. We are not surprised to meet with statements to the effect that menstruation *per se* may produce a psychosis or aggravate the symptoms of one already present. Not only the laity, but the profession, is too prone to attribute to the menstrual process a most important rôle in relation to mental function both in states of health and disease. The experience of Tausig led him to conclude that only occasionally was a psychosis aggravated during menstruation. Amenorrhœa is only an accompanying symptom or condition with the psychosis (35) but it is at the same time believed that menstruation may in some instances have a causal relation to certain psychoses. Haymann (36) who has made recently a most careful study of the relation of menstrual disturbances to psychoses, draws some very instructive conclusions from his work. He notes that cessation of the menses is very commonly associated with the psychoses. It occurs sometimes before the psychosis develops but more often after its incidence and during its course. It therefore cannot be looked upon as the cause of the psychosis with so much reason as the result. Haymann found amenorrhœa rather rare in paranoia, seldom in imbeciles and not more often in hysteric persons, psychopaths and degenerative insanity. Cessation of menstruation occurs in 50 per cent of epileptics, in about one third of manic depressives, with about equal frequency in the excited and depressed phases. It is most common in dementia præcox, especially catatonic forms, and also, in the organic psychoses. In dementia præcox this cessation is coincident with a loss in weight, and with the return of the menses there is also a gain in weight. However, in this disease, the menstrual irregularity itself is of no more value in diagnosis or prognosis than is the change in weight alone.

D INDICATIONS FOR GYNECOLOGICAL OPERATIONS OR TREATMENTS AND OTHER FEATURES INCIDENT TO SUCH PROCEDURES

That mental disorders do occasionally clear up following gynecological treatment,

and especially if this be operative, must be admitted. But are there not possibly other factors to consider aside from the operation on the local condition itself? The psychic effect has already been mentioned. Incident to operative aftercare several factors which are recognized to have an influence for the betterment of mental cases come into play. Principal among these should be mentioned the rest in bed, oftentimes enforced by restraint, and the special dietary measures employed. In too many institutions for the care of the insane, custodial measures are paramount while actual modern hospital treatment, as practiced in general hospitals today, comes into existence only under quasi extraordinary occasions, in which class belong surgical operations. In other words, a patient who has been subjected to operative treatment receives that sort of general hygienic and medical care which is best calculated to benefit the mental as well as physical health. Therefore, how much credit for cure should be given to this aftercare and how much to the operation itself is an open question which deserves some consideration in the evaluation of the curative rôle of surgery and its necessitated improved medical attention during the period of operative convalescence. It must be remembered too, in this connection that other occurrences during the course of a mental disease, more accidental in character than are operations, may sometimes bring about a clearing of the mental state. Thus we see a case of dementia præcox greatly improve or even recover incidental to the appearance of an acute tubercular or other acute infective disease. Cases of paranoia may drop their delusions and become apparently rational during the later stages of a carcinomatous involvement of the breast or abdominal viscera. It is, in fact, upon the basis of such observations that the production of sterile abscesses has been recommended as a therapeutic procedure in some mental disorders. These instances are cited simply to emphasize the point that we must not lose sight of the fact that real or apparent cures or improvements in psychoses following operation may not be due immediately to the operative results so much as to altera-

tions which we do not thoroughly understand and which are indirectly brought about in the organism as a whole. That is to say, we must be careful not to attribute the good to the operation alone because it is the most obvious explanation at hand.

Regarding the indications for gynecological operations on the insane there has existed some difference of opinion, more so in the past than now. Opinion has swung from one extreme to the other and finally come to rest, at least for the present, in the midway position of conservatism. About twenty years ago operative indications were not based upon the condition of the genital organs but rather upon the mental state. Rather rapidly opposition to such practice acquired force and it was then thought that gynecological operations should be performed on the insane only when physically urgent. The consensus of opinion today may be said to be that gynecological operations on the insane are indicated practically as they are on the sane, that no operation should be performed because of the mental state but only when the local conditions make it advisable and when the mental disease permits or does not contra-indicate. We may now well use the statement of Hobbs made nearly two decades back, although in a different sense from that which he intended it, that "surgical gynecology among the insane has already passed the experimental stage, and the practical results obtained, claim for the subject the recognition and encouragement which its importance demands." That gynecology has a place in our hospitals for the insane is manifest but that it can act as a cure-all for mental disease in general is absurd. Fortunately this latter extreme attitude is now rare among gynecologists, as it always has been among the more conservative, and operations are more generally carried out now either because the local condition makes it necessary or because it is thought that the genital disease may serve as an irritant and thus constitute one more element tending to prolong the psychosis. However, as Walthard cautions, gynecologists should take care to recognize the psychic element when present and in

some cases undertake no operation or local treatment unless urgent, even though genital disease is present.

IV. CONCLUSIONS

In the foregoing pages an attempt has been made to consider the origin of the belief in the causal relationship of genital to mental disorder, to review the theories which have been advanced in explanation of the character of such relationship, to analyze the data which have been presented in support of such theories, and finally, to determine what is the present attitude toward the matter. Such an attempt must of necessity cover an extensive territory, and therefore, it becomes obvious that not much more than an outline will be possible in the space allotted on this occasion. However, what have appeared to be the most definite points of contact between genital disorder and the psychoses proper have been given consideration commensurate with their estimated importance.

One cannot examine far into this general subject without being impressed with the wide difference of opinion which has obtained, not only between the gynecologist and the psychiatrist, but among gynecologists and psychiatrists themselves. Absolutely contradictory views have been held at different periods and even at the same time. Of course, as is equally true of many other phases in the development of medical knowledge, speculation has been rampant and conclusions have been drawn from inaccurate or inadequate observational data. Definite issues have been obfuscated by cloaking in more or less metaphysical terms. The more conservative have always stood forth to check the psychotherapeutic neurologist as well as the operating gynecologist, but not always have they been able to preserve the balance of opinion. Thus, in regard to the treatment of mental disease, we have run the gamut from advisement of complete oophorectomy in genitally normal females to non-operative treatment in females with demonstrable genital disease. No one can argue that both of these views can be correct. It is natural that in the course of time, with here and there the exception in an occasional

yet, the springs should have found their normal level in the attitude of general conservatism which today prevails.

In the more recent of the theories which have been proposed it is somewhat problematical whether we have something actually new other than in name. For instance, may not the toxic or endocrine theories be merely terms used to express in more modern language what was formerly less definitely (scientifically) understood by the term reflex? Have we found that any proof exists indicative that a toxic or endocrine disorder referable to the female generative tract acts as a cause in the production of any psychosis? So far as I have been able to ascertain, with the exception of puerperal infections and the like, there is none. Some years ago the writer took occasion to point out (38) that it was largely by analogy that we came to assume that some toxin might be the cause of mental disorder. And "so it happens that whenever problems concerning the etiology of mental disorders are brought up for consideration the discussions abound with such vague indefinite and meaningless expressions as malnutrition auto intoxication, exhaustion, toxins etc. the only inference from which often seems to be that the user endeavors to postulate some hypothetical disturbance of the metabolic functions, in the attempt to elucidate some point in etiology which, in his scheme of causation, is still obviously obscure and wanting explanation." As far as we have been able to ascertain, the facts available do not warrant the assumption that diseases of the ovary or disorders of its internal secretion are in themselves responsible for the production of mental disease.

It has been shown that the observations which have been brought forward to support the belief that genital disease may act to cause insanity in women, or that the local treatment of such disease may act to cure such psychoses have not taken into consideration certain important phases and accessory factors and are, therefore, subject to other interpretations than those which have been placed upon them. The ratio of male to female insane and the comparative frequency of gynecologic disease in mentally

normal and insane females does not bear out the contention that this etiologic factor deserves the importance credited to it by some. The statistics show that there are actually fewer female insane than male and that among the former gynecological diseases is, if anything, less frequent than among not insane females. In the evaluation of the effect of the gynecological treatment on the cure or treatment of the mental disease, the greatest error has arisen because of the absence of adequate psychiatric estimation of the type of psychosis concerned. It is, therefore, not greatly surprising to learn that the vast majority of mental cures reported have occurred in psychoses which the psychiatrist recognizes are more or less acute and self limited. In these cases recovery will take place, it may almost be said, in spite of treatment. Where operative indications exist, and it is now the consensus of opinion that they are the same in the insane as the sane the results obtained by operation should not be considered apart from the possible effect of such measures as are instituted during the period of post operative care. Rest in bed selected diet, and generally improved hygienic surroundings are means employed to cure mental disorders and these are just the measures which are often first brought into action during the post operative period. The operation itself is usually the smallest part of the treatment in many instances.

What has been said of gynecological disease applies almost equally well to the process of menstruation. Although the menstrual period is accompanied normally by a certain group of phenomena referable in part to alterations of function of the nervous system, although these are sometimes exaggerated in so-called "nervous women," it has not been shown that menstruation itself is the cause of a psychosis. Menstrual anomalies do occur in the insane but it would seem that they owe their occurrence more to the deranged function of the nervous system rather than that the latter depends upon the former.

We have in part accounted for the fact that female genital disease may cause insanity. The widespread belief that gynecologic mo-

which has been, and is yet, held by the public at large and by the general profession is certainly an important element. This popular belief should be looked upon as a superstition which must be lived down. It is, however, a fact that there are some gynecologists of wide following who do still claim that mental disease is due to genital disorder and that treatment of the former should be by the removal of the latter. The advocates of this belief are really but few in number while the opposite stand is taken by the more conservative majority. The history of the development of medical knowledge is marked by the evolution and decay of fads and fancies such as we have had under consideration. The calm judgment of the majority, both psychiatrists and gynecologists, tends at present strongly to the belief that in female genital disease or dysfunction we do not find a cause of insanity and that gynecological treatment, even where indicated, cannot be recommended as a cure for the psychoses.

V BIBLIOGRAPHY

- 1 GRAVES, W. P. Relationship between gynecological and neurological diseases. *Bull. Mass. M. Soc.*, 1913, xxi, 197.
- 2 ROUTH, G. H. The etiological relation of pelvic disease in women to insanity. *Brit. M. J.*, 1897, 1, 766.
- 3 HOBBS, A. T. Surgical gynecology in insanity. *Brit. M. J.*, 1897, 1, 769.
- 4 HOBBS, A. T. Pelvic lesions in relation to their distinctive effects upon mental disturbances. *Buffalo M. J.*, 1902, xli, 473.
- 5 SCHULTZE, B. S. Gynaekologie und Psychiatrie. *Monatsschr. f. Geburtsh. u. Gynaek.*, 1914, xl, 276.
- 6 RUSSELL, J. The after-effects of surgical procedure on the generative organs of females for the relief of insanity. *Brit. M. J.*, 1897, 1, 770.
- 7 MANTON. Cited from discussion in reference 1.
- 8 BOSSI, L. M. Die gynaekologischen Laesionen bei der Manie des Selbstmordes und die gynaekologische Prophylaxe gegen den Selbstmord beim Weibe. *Ztschr. f. Gynaek.* 1911, xxxv, 1265.
Idem. *Neuropscopatie di origine genitale e altri problemi di iniziativa della ginecologia italiana.* *Ginecol. mod.* 1915, vii, 7.
- 9 PINEL. Cited from Prichard.
- 10 PRICHARD, J. C. A Treatise on Insanity, etc. 1837, p. 99, 136.
- 11 REGIS, L. Précis de psychiatrie. Paris, 1906, p. 554.
- 12 WALTHER, M. Ueber die Bedeutung psychischer rotischer Symptome fuer Gynaekologie. *Zentralbl. f. Gynaek.*, 1912, xxxvi, 489.
- 13 CARSTENS, J. H. Nervous conditions and their relations to pelvic diseases. *N. Y. M. J.*, 1913, xxviii, 407.
- 14 DRECHT, F. N. The nervous symptoms of pelvic disease. *Am. M. J.*, 1913, xli, 767.
- 15 GRIESINGER, W. Die Pathologie und Therapie der psychischen Krankheiten. Braunschweig, p. 205.
- 16 KRAEPELIN, E. Psychiatrie, 1903, 1, 73.
- 17 BONHOEFFER, A. Die symptomatischen Psychosen, 1910.
- 18 SAJOURS, C. E. The theory of the internal secretions. Practitioner, Lond., 1915, xciv, 179.
- 19 HALSTED, W. Quoted from Sajours.
- 20 BELL, W. BLAIR. The relation of the internal secretions to the female characteristics and functions in health and disease. *Proc. Royal Soc. Med.* 1913 and 1914, vii, Gynaec. Sect. 47.
- 21 IDEM. The use of hormones in gynecological and obstetrical disorders. Practitioner, Lond., 1915, xciv, 263.
- 22 HARTMAN, H. R. Plunglandular insufficiency. Practitioner, Lond., 1915, xciv, 136.
- 23 MEYER, Ueber die Einwirkungen der Blutdruesen auf den Ablauf psychischer Funktionen. *Beit. klin. Wehnschr.*, 1912, xliix, 582, 649.
- 24 HYSLOP, T. B. Internal secretions and the psychoses. Practitioner, Lond., 1915, xciv, 310.
- 25 KASTAN. Die Pathogenese der Psychosen in Lichte der Abderhaldenschen Anschauungen. *Ztschr. f. d. ges. Neurol. u. Psychiat.*, 1914, x, 52.
- 26 KAYE, Die Abderhaldenschen Scroreaktionen in der Psychiatrie. *ibid.*
- 27 PLAUT. Das Abderhaldensche Dialysierverfahren in der Psychiatrie. *ibid.*
- 28 HILFERT and ROSENAL. Zur Frage der klinischen Verwertbarkeit der Abderhaldenschen Dialysierverfahrens in der Psychiatrie. *ibid.*
- 29 TAUSIG, F. J. Gynecologic diseases in the insane and its relationship to the various forms of psychoses. *J. Am. M. Ass.*, 1912, lix, 713.
- 30 GIBSON, G. N. Y. M. J., 1915, ci, 203.
- 31 TUXE, D. HACK. A Dictionary of Psychological Medicine, 1892.
- 32 U. S. CENSUS. Insane and feeble-minded in institutions, 1910. Bureau of the Census, Washington, 1914, p. 40.
- 33 TOPFER. Cited from Graves.
- 34 KOENIG and LINZENMEIER. Ueber die Bedeutung gynaekologischer Erkrankungen und den Wert ihrer Heilung bei Psychosen. *Arch. f. Psychiat. und Nervenkrankh.*, 1913, li, 1002. This paper contains a most thorough review and criticism of the works of Bossi and has been depended upon largely for a knowledge of Bossi's published cases.
- 35 BOSSI. Gynaekologie und Psychiatrie. *Med. Klin.*, 1913, ix, 1194.
- 36 PERETTI. Gynaekologie und Psychiatrie. *Med. Klin.*, 1912, viii, 1857.
- 37 ANGELLOTTI and PIERACCINI. Cited by Koenig and Linzenmeier.
- 38 MCCORD, C. P. *J. Am. M. Ass.*, 1915, lxxv, 517.
- 39 GORDON, A. Nervous and mental disturbances following castration in women. *J. Am. M. Ass.*, 1914, lxxiii, 1345.
- 40 PASSOW. Wechselseitige Beziehungen zwischen Psychosen und Menstruationsstörungen. *Med. Klin.*, 1914, x, 407.
- 41 HAYMAN, H. Menstruationsstörungen bei Psychosen. *Ztschr. f. d. ges. Neurol. u. Psychiat.*, 1913, xv, 511.
- 42 SIEMERING, F. *Ztschr. f. Gynaek.*, 1912, xxxvi, 33; *Monatsschr. f. Geburtsh. u. Gynaek.*, 1914, xxxix, 269.
- 43 BARNES, F. M. JR. Chemistry of nervous and mental diseases. *Am. J. Insanity*, 1912, lxxviii, 431.

HERNIAS OF THE URINARY BLADDER¹

a. NATURE. b. MODERN OPERATIVE TREATMENT. c. CONCLUSIONS

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THE permanent or temporary escape of a part or the whole of the urinary bladder, through any of the usual or unusual hernial orifices, is uncommon. Nevertheless, many case histories have been published and a much larger number allowed to pass without being recorded. In a long series of hernia operations, every surgeon is certain to meet with some instances of hernia of the bladder. The urinary bladder in part or in its entirety is present in 1 per cent of all hernias.

Though the term hernia implies the presence of a hernial opening, of a hernial sac, sac-contents and sac coverings, we know that in many hernias of the urinary bladder the sac is either incomplete or totally absent. However, to designate the clinical entity under consideration, we fail to find any other term more appropriate more sanctioned by long usage than that of hernia of the urinary bladder.

Many operators without their knowledge have punctured, incised, ligated, or removed a herniated bladder process and then closed the hernial canal and operative wound in the usual way. Bladder protrusions have been excised by mistake for hernial sacs, or stitches used to close hernial canals have been passed too deeply and found at the necropsy to have caught the bladder.

As vaginal bladder hernias fall more appropriately within the domain of the gynecologist, we did not include them in this contribution. All the hernias herein considered are external hernias that is, their outermost overlying saccular covering was skin, each after reaching a certain stage of development gave rise to a more or less visible and palpable, external swelling in the obturator, fe-

moral, inguinal, or other region, depending upon the anatomical location of the hernia.

We will discuss the subject under the following subheads:

1. Incidence as to age, as to sex, as to side involved
2. Anatomical types
3. Clinical types
4. Etiology
5. Symptomatology
6. Clinical manifestations
7. Operative findings
8. Diagnosis
9. Treatment
10. Conclusions

INCIDENCE AS TO AGE

In most cases it was not possible to ascertain the age at which the hernia first appeared. We therefore tabulated the age of the patients at the time of operative relief. In three cases, the patient's age at time of operation is not or is indefinitely stated. The other patients at time of operation were from

16 to 25 years old	9 cases
26 to 35 years old	27 cases
36 to 45 years old	31 cases
46 to 55 years old	36 cases
56 to 65 years old	19 cases
66 to 75 years old	15 cases
76 to 80 years old	5 cases

Our personal clinical observation and a review of the literature justify the following conclusions as to age incidence of hernias of the urinary bladder:

a They are extremely rare in infancy, childhood, and adolescence. During the first year of life, not one patient, and previous to the sixteenth year, only 13 patients are reported to have been operated for hernia of the urinary bladder.

b They are most frequent after the fortieth year of life. Ninety-one patients out of 159 unselected consecutive herniated in-

¹ This article is based on an analysis of all the vesical hernias reported with sufficient data in the English, French and German languages from 1866 to 1914 inclusive (literature to which access can be had at the John Crerar Library, Chicago, Illinois) and also of seven unpublished personal cases (159 patients; 101 recent; 104 vesical hernias).

dividuals were operated on for the relief of this condition during the fifth and subsequent decades of life. Five of these patients, presented each a right and a left vesical hernia.

c Hernia of the bladder is an infirmity occurring chiefly in advanced life.

INCIDENCE AS TO SEX

Hernias of the urinary bladder, like all hernias of viscera common to both sexes, are found more frequently in males. The 164 hernias herein studied and analyzed were distributed as follows: Masculine pseudo-herniaphrodite, 1 case, females, 62 cases, males, 96 cases.

Case reports show that, in the female, these hernias occur in nulliparæ, in primiparæ, and in multiparæ. They first become manifest either before, during, or after gestation, or between successive pregnancies.

In looking over the cases, we find that vesical hernias have occurred in:

I para	5 times
II para	3 times
III para	2 times
IV para	1 time
VI para	1 time
VIII para	2 times
IX para	1 time
XIV para	1 time
Multipara	3 times

In the other subjects, no definite statement is made as to pregnancy.

INCIDENCE AS TO SIDE INVOLVED

Most hernias of the urinary bladder are unilateral. Out of 159 patients suffering from this infirmity, only 5 presented double vesical hernias. In 37 females and 51 males, the hernia was on the right side, in 17 females and 41 males, it was on the left side. We thus see that hernias of the urinary bladder show in both sexes a noticeable predilection for the right side.

In bilateral hernias, both hernias either appear simultaneously, or, as is more frequent, an interval of time, measured in weeks, months, or years, elapses between the appearance of the first and that of the second hernia.

ANATOMICAL TYPES

Hernias of the urinary bladder appear at

various anatomical sites. Indirect or oblique inguinal hernias escape from the abdomino-pelvic cavity, above Poupart's ligament, by way of the external inguinal fossa, and follow in their progress outward the course of the spermatic cord in the male, or of the round ligament in the female. They are complete or incomplete, according as the herniated viscus or viscera emerge or not beyond the external opening of the hernial canal. The complete are pudendal or scrotal. In the former, the hernial swelling descends into a labium majus, in the latter, into a scrotal pouch.

Direct inguinal hernias escape from the abdominal cavity by emerging through either the middle or the internal inguinal fossa and first appear externally at the superficial abdominal ring. Direct inguinal hernias are always to the inner or medial side of the deep epigastric vessels, and, unlike the indirect, do not follow the entire course of the inguinal canal.

In our cases, we find 27 patients with direct inguinal hernias and 87 with indirect or oblique inguinal hernias. Of the 27 patients with direct inguinal hernias, 5 were females. Direct hernias are very rare in the young. Of the 87 patients, 13 with indirect or oblique inguinal hernias were females.

In our list of cases, there were 42 femoral hernias, 40 of which occurred in female patients and 2 in males.

What precedes shows that—

a Inguinal vesical hernias are more common in men than in women.

b Femoral vesical hernias are far more common in women than in men.

c Femoral hernias of the urinary bladder are an exception to the general rule, which is that inguinal hernias are more frequent in women than femoral hernias. Forty female patients presented femoral vesical hernias and only 17 presented inguinal vesical hernias.

d Direct inguinal vesical hernias are of frequent occurrence. Out of 114 inguinal vesical hernias, 27 were of the direct variety, that is, in 27 cases the herniated bladder process was to the inner side of the deep epigastric artery.

Gladstone's case of left obturator extra-

peritoneal bladder hernia is the only obturator vesical hernia reported in the period covered by this paper. It coexisted with a right obturator tubal hernia of the third variety and a right reducible femoral intestinal hernia.

Gerulanos' and Tedenat's cases were irreducible suprapubic hernias of the linea alba, consisting solely of a prolapsed bladder diverticulum. In these 2 cases, both of which occurred in VIII-paras, the pedicle of the hernial swelling passed above the upper surface of the symphysis pubis, and had emerged from the abdominal cavity through a round orifice between the two recti muscles.

According to the relation which the bladder protrusion bears to the peritoneum, hernias of the urinary bladder are classified into the following three varieties:

a Intraperitoneal, in which there is a complete hernial sac.

b Paraperitoneal, in which the herniated bladder-process is covered by peritoneum on one surface.

c Extraperitoneal, in which the herniated portion of the bladder is neither engaged in, nor contiguous to, a hernial sac.

In the intraperitoneal variety, the herniated portion of the bladder has a complete peritoneal covering and is contained in a true hernial sac. In the paraperitoneal variety, the herniated bladder process lies to the inner side of the sac, and its serous covering enters in part into the formation of the hernial sac. Part of the herniated bladder-process has no peritoneal covering. The paraperitoneal form is not uncommonly a sliding hernia, and is frequently due to a continuous pull and traction exerted by the sac of an existing enterocele, epiplocele or entero epiplocele upon the peritoneal covering of the urinary bladder. In the extraperitoneal variety, the herniated bladder-process has no peritoneal covering. The prolapsed bladder is neither present in nor does it enter into the formation of a hernial sac. The extraperitoneal bladder-protrusion is in relation with the subcutaneous tissues and is always distinct from and to the inner side of the hernial sac, if one be present.

In the 164 reported cases, the hernia is definitely stated to have been—

Intraperitoneal in 4 cases (females, 1 case).

Paraperitoneal in 53 cases (females, 21 cases).

Extraperitoneal in 58 cases (females, 22 cases).

In the cases not included in the above tabulation, the relation of the herniated bladder-process to the hernial sac, when one was present, is not precisely recorded.

CLINICAL TYPES

Any hernia of the bladder, be it intraperitoneal, paraperitoneal or extraperitoneal, may be reducible, irreducible, inflamed, obstructed, or strangulated.

If the contents of a hernial sac return spontaneously to or can be manipulated back into the abdominal cavity from which they have escaped, the hernia is said to be reducible. At first, most vesical hernias are reducible, the larger number, sooner or later, become irreducible. Reduction of hernial contents, spontaneous or manual, may be temporary, may be permanent, and is effected with more or less difficulty (general anaesthesia may be required). In our collected cases, there were 48 hernias, the contents of which could be completely reduced. Of these, 16 occurred in female subjects.

If the hernial sac-contents cannot be manipulated back into the abdominal cavity, the hernia is said to be irreducible, provided that the irreducibility *per se* does not cause any functional disturbance of the herniated organ or organs, and none or but slight interference with the blood supply thereof. The irreducibility may be recent or of long duration. Partial or complete irreducibility predisposes to inflammation, obstruction, and strangulation, and is either of sudden or of gradual onset. We noted 58 irreducible vesical hernias, 21 of which occurred in females.

If communication between the herniated and the non-herniated portion of the bladder be more or less interfered with, the urinary bladder being transformed, in some instances, into a *bissac*, the hernia is said to be obstructed.

If, in addition to irreducibility of the sac-contents, the blood supply of the herniated organ or organs is interfered with to such a

degree that their vitality is endangered or lost, the hernia is said to be strangulated. Strangulation may follow a paroxysm of coughing, heavy lifting, a fall, any strong muscular effort associated with great sudden increase of intra-abdominal pressure. There were 22 strangulated hernias, 11 of which occurred in females. In some cases, the hernia of the bladder exists alone and becomes strangulated. In some of these strangulated cases, the vesical hernia was associated with an enterocoele, an epiplocele or an entero-epiplocele, the bladder was not constricted, and the herniated omentum or intestine or both were strangulated. In others, the bladder was strangulated and the herniated omentum, intestine, or both were not constricted. The bladder-wall offers more resistance to constriction than does the intestine. Strangulation of the bladder is especially grave if renal disease coexists.

ETIOLOGY

The etiology of these hernias is largely the etiology of hernias in general. In the causation of this pathological lesion, the following factors are of importance.

A All conditions that tend to increase intra-abdominal pressure

1 Occupations necessitating repeated muscular efforts associated with increased intra-abdominal tension, as the lifting or pushing of heavy weights, etc (over twenty cases in our series)

2 Physiological or pathological states which distend the abdominal cavity, stretching the abdominal parietes, and widening the orifices normally present in the muscular and aponeurotic layers of the abdominal wall (enteroptosis, obesity, abdominal tumors, ascites, pregnancy, etc)

3 All diseases associated with frequently repeated increase of intra abdominal pressure (long-standing lung affection, pulmonary emphysema, chronic bronchitis, habitual constipation, etc)

B All conditions which weaken the abdominal wall

1 Acute or chronic diseases debilitating the organism, especially such as cause great emaciation

2 Obesity weakens the abdominal wall and increases the intra-abdominal pressure.

3 Traumatism Most often the traumatism does not cause the hernia, but only reveals its existence (abdominal operations). Pathologic adhesions of viscera or omentum to the anterior parietal peritoneal wall near a hernia opening may act as a predisposing cause

4 Previous hernia operations

5 Enterocoeles, epiploceles and entero-epiploceles

6 Feeble development or atrophy of the aponeurosis of the transversalis muscle and of the conjoined tendon. This factor is of great importance in direct inguinal hernia

7 Unduly large hernial rings

8 Excessive breadth of hernial canal

9 Congenital defects present in abdominal wall

10 Inherited or acquired weakness of abdominal wall

11 Pre existing hernial sacs of prenatal and post-natal formation

C All conditions associated with prolonged overdistention, overstretching, impaired contractility, restricted mobility, etc, of the urinary bladder.

1 Congenital malformations of the bladder.

2 Diseases of the lower urinary organs, impairing the expulsive force of the bladder or abnormally hindering the outflow of urine (vesical catarrh, prostatic hypertrophy, urethral stricture, phimosis, etc)

3 Abnormal increase of the perivesical fatty connective tissue (lipome pré-vésical).

SYMPTOMATOLOGY

Hernias of the urinary bladder are congenital or acquired, recent or recurrent, and of greater or shorter standing. They vary in shape, volume, rate of growth, and in amount of discomfort and disability entailed. Occasionally they occur at the site of a previous hernia operation.

Hernia of the bladder is usually an acquired condition. It occurs most commonly in late adult life and is, not infrequently, secondary to pelvic, vesical, and urethral diseases. Twenty-seven patients presented direct in-

guinal hernias Direct inguinal hernias are said to be always acquired hernias Forty-two patients presented femoral hernias Except one case, that of a five-year-old female child reported by the author to be an acquired hernia, all these femoral hernias first became manifest in adult life Congenital femoral hernias are pathological rarities Femoral hernia is essentially a hernia of adult life Congenital hernias appear at all periods of life Even at the time of operation, one may be unable to differentiate between a sac of prenatal and one of post-natal formation

Size is variable A few of the reported hernias were simply pointed, some were hazelnut sized, lima bean sized, pigeon-egg-sized, goose-egg sized, others had the volume of a fist, of two fists, of a foetal head In many, the hernial swelling is said to have been large, voluminous

The hernial swelling may be cylindrical, ovoid, elongated ovoid, it may be grooved or bilobed, soft, elastic, and fluctuating, or hard and non-elastic The hernial swelling may be a large, tense, smooth tumor, may occupy the scrotum, may extend as far as the middle of the femur, may occupy the entire left labia, distorting the vaginal opening

The size of the hernia is likely to change rapidly and considerably, being influenced by clinical type of hernia, position of body, amount of urine present in bladder, etc The hernial swelling gives a dull or tympanic percussion note

Pain is an inconstant symptom Ten of the reported cases are said to have been painless

Diverse urinary disturbances (subjective and objective) may be present These disturbances may be occasional or constant

The subjective urinary disturbances are frequent urination, painful urination, pain at close of urination, difficult urination, (Patient, in order to urinate, may find it necessary to elevate or to compress the scrotum and its contents, or to both elevate and compress the scrotal contents These patients sometimes resort to unusual positions to empty their bladder dorsal decubitus In a few cases, on account of the narrowing

or compression of the joining isthmus, considerable difficulty is experienced in emptying the scrotal portion of the bladder into the pelvic portion), vesical tenesmus (pressure upon hernial swelling gives desire to urinate), burning on urination.

The objective urinary disturbances are increase of swelling with accumulation of urine, decrease with voiding, two-step urination (miction *à deux temps* associated with a simultaneous lessening of the hernial swelling)

The injection of fluid into the bladder causes an increase in size of the hernial swelling A sound introduced into bladder may enter the herniated bladder-process A cystoscope introduced into bladder may show the round contour of the normal bladder distorted into T-shape, may show the vesical opening of the herniated bladder-process, etc

Vesical hernias may exist alone, may be one of two or more hernias, may coexist with a hernia of other organ or organs on the same or opposite side of the body Other congenital or acquired anomalies may be present: phimosis, ectopia testis, inguinalis, cryptorchism, vaginal cystocele, hydrocele, prolapso uteri, hydrocele of hernial sac, etc

PATHOLOGY

In many cases, note is made of the excessive breadth of the hernial canal, of enlarged hernial rings The spermatic cord may be to the outer side of the hernial swelling, may be spread out over the hernial sac, may be behind the sac, may be below and external to the sac, may be spread out over bladder (anterior and outer surfaces)

To differentiate a hernial sac of prenatal formation from one of post natal formation is at times difficult at times impossible

Acquired hernial sacs, except in hernias "par glissement," are always entirely derived from the parietal peritoneum

The sac may be thin or thick, congested and infiltrated, intimately adherent to the spermatic cord, and, not uncommonly, is capped by a thick mass of fatty tissue

An extraperitoneal bladder hernia has no serous hernial sac A pseudosac, consisting of connective tissue, overlies the herniated

bladder-process This connective tissue may be much attenuated or much thickened.

There may be an unusual amount of fat in the hernial canal. In the extraperitoneal and paraperitoneal forms, the herniated bladder-process is frequently covered with fatty tissue, the "lipome herniaire" of the French authors. This prevesical accumulation of fatty tissue is thought by many to be an important contributory etiological factor.

In the paraperitoneal hernias, the serous sac is, at one point, intimately adherent to the bladder-wall. In the paraperitoneal and also in the extraperitoneal types, if a sac be present, the bladder is always to its inner, to its medial side, and, at times, below. The bladder may be adherent to the hernial sac, may be adherent to the spermatic cord.

The amount of viscus present in hernial swelling may be small, or it may be large. In some cases, the hernial swelling consists solely of the herniated bladder process and of the increased amount of fatty tissue overlying it, in other cases, as in our series, of the herniated bladder process or bladder diverticulum and of an empty serous hernial sac. In a large number of cases, the hernial swelling includes a herniated bladder-process and a distinct or contiguous serous hernial sac with or without sac-contents. The hernial sac-contents noted in the reported cases may be hernial fluid, a part of right ureter, omentum, small intestine, large intestine, intestine and omentum, small and large intestine.

In the strangulated cases, such contents as the following were noted: Hæmorrhagic fluid and the bladder, bloody fluid, gut and ovary, a loop of congested intestine and urinary bladder, congested bluish appendix epiploica, reddish brown fluid, bladder diverticulum and small intestine.

The wall of the herniated bladder-process may be normal, thinned, or thickened. The herniated bladder-process may present the appearance of an empty or of a thickened hernial sac. Its cavity communicates with the cavity of the non-herniated portion of the bladder by means of a wide or narrow channel. It may be the seat of tuberculous disease, of carcinomatous disease. Calculi may be pres-

ent in the herniated and in the non-herniated portion of the bladder.

The spermatic cord is sometimes found spread out over the vesical hernia, at times is distinct from it, and often is in close relation with coexisting enterocele, epiplocele or entero-epiplocele.

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

The existence of a hernia of the urinary bladder may be ignored, suspected or diagnosed before operation. The diagnosis may first be made at time of operation, or not before one or more days after operation. Evidence of the bladder having been wounded may not be present until some time after the patient has left the operating table. It has happened to eminent clinicians to fail to recognize even in operated cases the true state of affairs previous to the autopsy.

Before operation, the following symptoms are suggestive of vesical hernias:

- 1 Urinary disturbances: dysuria, two-stage urination, frequent urination, scalding urination.

- 2 A hernial swelling, pressure upon which causes a desire to urinate, and which increases in volume with urinary retention, and markedly diminishes in size with urination.

- 3 A hernial swelling, the size of which is increased by air- or water-distention of the urinary bladder.

- 4 A hernial swelling in which fluctuation is detected or in which a metallic sound can be introduced by way of the urethra.

- 5 A hernial swelling, in which, after easy reduction of most of the contents, there persists a small doughy mass representing the extruded part of the bladder.

During the course of a hernia operation, the following symptoms or signs are suggestive of vesical hernias:

- 1 An unusual amount of fat in the neighborhood of a hernial swelling.

- 2 Difficulty in finding or in isolating the true hernial sac from the tumor mass.

- 3 The trabeculated appearance of the bladder muscularis.

- 4 Large-sized external hernial opening and the fact that hernias of the bladder are usually nearer the median line than true hernial sacs.

5 The occurrence of a second hernial sac is so rare that it is a safe rule to regard as the urinary bladder, until proved otherwise, any structure resembling a second hernial sac.

6 The pedicle of a herniated bladder-process leads down behind the pubic bone into the true pelvis, the pedicle of a true hernial sac leads to the general peritoneal cavity.

Passage of sound into a cystocele, cystoscopic confirmation of its existence, escape of urine following wounding of bladder (31 cases)—all these are conclusive signs.

Keep in mind that vesical hernias are frequently associated with intestinal and omental hernias.

Injury of the bladder may not be noticed at the time of operation and be diagnosed, for the first time, several hours after operation by

a Voluntary voiding or withdrawal by catheter of blood stained urine

b Urine escaping from the hernial operative wound. This is usually preceded by the development and subsequent rupture or incision of a urinary phlegmon.

c Sepsis due to urinary extravasation

d Peritonitis due to escape of urine into peritoneal cavity

TREATMENT

In discussing the treatment, we will limit ourselves to the consideration of femoral and inguinal hernias.

An operator not on his guard may incise the bladder under the belief that he is opening a hernial sac. In operating upon recurrent hernias, guard against wounding the bladder. If isolation of the hernial sac from the inner lower portion of the ring be difficult, involvement of the bladder is to be suspected. Avoid this injury by securing a good exposure of the operative field. The more exact the stripping of the sac quite up to the deep epigastric artery, the more likely will cystocele, especially in its earlier stages, be discovered.

Vesical hernias can be produced by traction upon the sac, and efforts to place the ligature high up may, if one be careless, result in catching in its bite the bladder-wall.

The bladder was accidentally injured in 68

of the cases under consideration. In 31, urine escaped into the operative field at time of operation.

Should the bladder be incised or otherwise injured, carefully suture it and provide appropriate drainage. Immediate closure of the bladder wound is of primary importance. It is effected by two, in some cases by three, layers of interrupted or continuous sutures. Introduce your bladder-sutures so as to include all the layers of the bladder wall, the mucosa excepted. Needless to say that only absorbable suture-material is to be employed. Even if the bladder be not opened, but merely injured, it is safer to fortify the weak spot by the introduction of a few catgut sutures.

The herniated urinary bladder-process may be (a) injured in attempts to carefully and cautiously separate surrounding adhesions (not only must one be careful as to sac contents, but also as to contiguous tissues), (b) torn accidentally in trying to separate it from the hernial sac (the herniated bladder-process is more liable to be injured if it be the seat of such changes as are incident to strangulation), (c) punctured or pricked in suturing walls of hernial canal, in closing hernial orifice, (d) incised or ligated and cut off, being mistaken for a hernial sac.

Resection of the herniated bladder-process is indicated only if it be very much attenuated, necrotic, or the seat of other serious degenerative changes. Resection is to be followed by suture of the bladder-wound. If a calculus or calculi be present in the bladder protrusion, incise the bladder-wall, remove the foreign body, and repair vesical wound secundum artem. As a routine procedure, resection of the bladder protrusion is not to be recommended. It was performed only in 12 of the reported cases.

If the bladder protrusion be apparently normal, free it from surrounding adhesions, if any be present, and then reduce it into the abdominopelvic cavity. As a routine procedure, bladder repair, bladder resection, and bladder reduction are always to be supplemented by resection of the abdominal wall. After isolation of the herniated bladder-process, supplemented by the repair of any

injury which it may have sustained during the course of the operative procedure, we advise that the bladder be reduced into the abdominal cavity.

Vesical hernias have been successfully operated on for radical cure without anæsthesia, under local, cocaine, infiltration, spinal, and general surgical anæsthesia (nitrous oxide gas and oxygen, chloroform and ether in the majority of cases).

For inguinal hernias, the Bassini operation with or without transplantation of the cord seems to be the operation most universally employed—41 times Czerny's, Andrews', Ferguson's, Halsted's and Kocher's type of operation were each employed once. Numerous other methods were employed.

Various types of operations were used in femoral hernias (Berger, Coley, Lotheisen's operations, etc.). Some operators closed the hernial sac by a ligature, others by a purse-string suture, others by suturing the edges. In 18 cases, it is stated that the hernial canal was freed of fatty tissue.

In all the cases in which the herniated bladder-process was not injured, in practically all those cases in which it was injured and repaired or resected and sutured, the organ, after being freed from surrounding adhesions, was returned into the abdominal cavity. Bernhard, in one case, after suturing the bladder, fixed it to the lower angle of the abdominal wound.

Operators are not agreed as to the advisability of using a permanent catheter after bladder suture, nor as to the time during which this permanent catheter, if used, should be left in the bladder. Some leave it in one day, some, two days, some, three days, some, four days, some, five days, some, six days, some, one week, some, two weeks.

Drainage extending to the bladder wound is a prudent provision against leakage from the sutured bladder. Many operators prefer, after bladder suture, to leave the abdominal wound open at its lower angle, and to close it as soon as conditions warrant.

If the hernial swelling contains in addition to a bladder process, a knuckle of gut, a piece of omentum or some other viscus, the

indication is first to free and reduce the bladder-process, and then carefully isolate, incise, and inspect the hernial sac contents. In the absence of contra-indications, all hernial sac contents, sac-fluid excepted, are to be returned into the cavity from which they have escaped.

A deviation from this rule is indicated in cases—

1 In which herniated omentum has undergone such inflammatory, cystic or other changes, that, if returned into the abdominal cavity, it might act as a foreign body.

2 In which the herniated gut or omentum is gangrenous or of doubtful viability.

3 In which the hernial contents are in such a pathological state that their return to the abdominal cavity would jeopardize the patient's life.

The treatment of the sac contents does not differ from that which obtains in hernial swellings in which no bladder-process is present; if those contents are injured by the surgeon, the injury calls for repair.

RESULTS

Operations for the radical cure of vesical hernias have practically no mortality. What mortality occurs is due to concomitant circumstances—extreme old age, great debility, shock, long-standing strangulation, and unrecognized bladder injuries.

One of these hernias was a dissecting-room discovery, this leaves 163 hernias occurring in 158 subjects. There were twelve deaths; all the other patients recovered.

Operations for the radical cure of vesical hernias are rarely followed by disagreeable sequelæ. In 13 cases, a urinary fistula complicated convalescence. These urinary fistulæ usually closed spontaneously. One can, if he so desires, close these fistulæ under cocaine anæsthesia.

A careful study of the cases in which death occurred shows that operations for the radical cure of vesical hernias have no mortality *per se*, if all bladder injuries be suitably repaired. In bladder hernias, recognized either previous to or at time of operation, before closure of the abdominal wound, recovery, of necessity, is rapid and uneventful.

CONCLUSIONS

1 The urinary bladder, in part or in its entirety, may escape from the abdominal and abdominopelvic cavities through any of the uncommon or common hernial orifices of the lower abdominal wall

2 Hernias of the urinary bladder occur in both sexes, at all ages, and in all races. They are congenital or acquired, recurrent, recent or of some standing, almost always unilateral, very rarely bilateral. Like other hernias, they vary in shape, size, rate of growth, and in the discomfort and disability which they entail.

3 In the female, vesical hernias occur in nullipara, primipara and multipara; they occur previous to, during, or after gestation and between gestations. They neither interfere with gestation nor disturb parturition.

4 According to the anatomical site, vesical hernias are designated as hernias of the linea alba, of the obturator, femoral, or inguinal regions. Anatomical relations justify the further subdividing of the latter into interstitial or intrapanetal, direct or indirect, complete or incomplete, pudendal or scrotal.

5 The relation of the herniated bladder-process to the serous membrane lining the peritoneal cavity is well expressed by the terms intraperitoneal, paraperitoneal and extraperitoneal. These designations are serviceable from the viewpoint of etiology, symptomatology, and treatment.

6 According to clinical manifestations hernias of the urinary bladder are reducible, irreducible, inflamed or strangulated.

7 A vesical hernia may be single, double or one of two or more hernias located on the same or opposite side of the body, having dissimilar contents, and presenting like or unlike anatomical and clinical characteristics. Thus, the same patient may present an inguinal cystocele and a femoral epiplocele, a reducible femoral vesical hernia, and an irreducible inguinal intestinal hernia. Case reports of an inguinal vesical hernia on one side coexisting with an inguinal enterocele, epiplocele or entero-epiplocele on the opposite side of the body are not uncommon.

8 As etiological factors in the causation of vesical hernias, the following are foremost

1. All conditions that tend to increase intra-abdominal pressure

2. All conditions, congenital or acquired, that weaken the abdominal wall

3. All diseases of the lower urinary organs that impair the expulsive force of the bladder or abnormally hinder the outflow of urine

4. Pre-existing hernias and hernial sacs of prenatal or post-natal origin

9. The pre-operative signs and symptoms may be unmistakable, vague, or absolutely wanting. In addition to such symptoms as are common to all other hernias, vesical hernias present peculiar suggestive and positive manifestations of their existence. Chief among the former are such disturbances of micturition as the following: frequent, painful and difficult urination, vesical tenesmus, urgent desire to urinate caused by pressure upon hernial swelling and two-step urination. Chief among the positive manifestations are a hernial swelling increasing in size with urinary retention and decreasing with urination, increase in size of a hernial swelling with air or water distention of the bladder and decrease upon withdrawal of these agents, passage of a sound into the herniated bladder process by way of urethra and bladder, cystoscopic demonstration of the vesical orifice of the herniated bladder process.

10. The herniated bladder-process may be the sole content of the hernial swelling, or merely one of the associated contents. In addition to a bladder process, a hernial swelling may contain a part of one or more of the following organs: ureter, fallopian tube, ovary, appendix vermiformis or appendix epiploiceus, omentum and small or large intestine.

11. The herniated bladder-process may be free or adherent to surrounding tissues or organs structurally normal or present degenerative, inflammatory or neoplastic changes, may be the seat of atrophy, hypertrophy, catarrh, gangrene, tuberculosis, or carcinoma, and may or may not communicate freely with the general vesical cavity. The herniated process of bladder may contain one or more calculi.

12. The vesical hernia may be the sole existing anomaly, or it may be one of two or

more congenital or acquired pathological states, having or not having any relationship of cause or effect to the hernia (cryptorchism, vaginal cystocele, prolapsus uteri, prostatic hypertrophy, etc.)

13 Truss treatment for hernias of the bladder is not curative, is often productive of discomfort and may injuriously affect the structure of the bladder-wall

14 In patients over ten years of age, all hernias, irrespective of anatomical site, clinical condition or contents, should, in the absence of a constitutional state contra-indicating operations of election, be subjected to an operation for radical cure

15 Clinical conditions so closely simulating hernias of the urinary bladder that a positive diagnosis without operation appears impossible, should be subjected to operative treatment. Only benefit can be derived from adherence to this rule. A diagnosis is established and a cure is effected

16 All hernias of the urinary bladder irrespective of sex, age or social condition of patient, irrespective of size, shape, anatomical site or clinical type, call for operative treatment. Operative treatment is free from danger and is curative. The only contra-indications to operative treatment are extreme old age and the co-existence of a pathological state or states contra-indicating operations of election. Operative treatment is the only rational treatment of hernia in the adult

17 In all incarcerated and in all strangulated hernias of the bladder, operative intervention is indicated

18 In all hernias the ideal time for operation is previous to the development of degenerative or other pathological changes in the herniated organ or organs and previous to the occurrence of any of the various complications incident to hernias

19 Women who suffer from any form of hernia should be carefully watched before, during, and after their confinement, so as to prevent or rather minimize any undue strain upon weak regions of the abdominal wall. These women, at the close of lactation or toward the end of the first year following their confinement, should, in the absence of

contra-indications, be subjected to an operation for radical cure of the hernia. In the female, the inguinal rings are comparatively small. They can be closed without inconvenience to the patient

20 The most popular and efficient modern hernia operations permit a full view of the operative field and allow such a careful examination of hernial rings, canals, and surrounding structures that a prolapsed or herniated viscus rarely escapes detection

21 In inguinal and femoral hernia operations, after the careful opening and isolation of the sac, see that the latter consists preferably of peritoneum only, and that its neck be freed from all other structures. The neck of sac should not be twisted, as by so doing the bladder is drawn toward the hernial opening and is liable to be included in the ligature. Necrosis and peritonitis result therefrom

22 In the course of a hernia operation, if, after opening of the sac and reduction of its contents, there appears a second sac, it is not to be opened, unless the introduction of a sound in the bladder shows the complete independence of this sac from the urinary reservoir

23 In hernias of the urinary bladder, first expose and free the herniated organ or organs, and then reduce it into the abdominopelvic cavity. Follow this by suppressing the hernial sac if one be present, and then, according to an approved method, strengthen the weakened hernial area. Resection of the herniated bladder-process is only exceptionally indicated. When performed, it calls for immediate reconstitution of the urinary reservoir

24 During hernia operations, the wounding of the urinary bladder can, to a large extent, be prevented by careful operating and by keeping this clinical entity in mind

25 Wounds of the urinary bladder inflicted during the course of hernia operations, gave a good prognosis if they be immediately, accurately repaired and if appropriate post-operative treatment be instituted. In the repair of bladder-wounds, two or three layers of continuous or interrupted absorbable sutures give satisfactory results. Bladder

suturing is to be followed by refection of the abdominal wall of the hernial area

26 If within twenty-four to forty-eight hours after a hernia operation on a healthy subject, the catheterized urine contains blood, determine the origin of that blood. If a bladder-injury be present, open the hernial operative wound or laparotomize, or do both and repair the injury

27. The mortality of operations for the radical cure of hernia, if performed at an opportune time by a rapid and skillful operator competently assisted, is practically nil. Coley operated upon 1,000 consecutive cases of hernia without a single death.

28. The operative treatment of hernias of the urinary bladder is highly satisfactory

CONCERNING THE VALUE OF SODIUM CITRATE SOLUTION IN THE PREVENTION OF PERITONEAL ADHESIONS¹

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SAXTON POPE (1) was the first to suggest the use of sodium citrate solution as a means of preventing the formation of adhesions following operations in the peritoneal cavity, and based its use on the fact that sodium citrate prevents the formation of fibrin from fibrinogen. After experimenting with citrate solutions of various percentages, he found that a 2 per cent solution in 3 per cent sodium chloride solution was the most suitable concentration. His results with this solution in his experimental work on rabbits were striking, and as there were no apparent ill effects in the clinical cases he referred to, the method seemed to warrant further experimental and clinical trial.

At the suggestion of L. L. McArthur I had a quantity of the solution prepared, put into flasks each containing 500 cc., sterilized on three successive days, and then kept at the proper temperature for immediate clinical use. I used the solution in one human case only. Although this was done very soon after I had started my experimental work on dogs, I shall first discuss my dog experiments, and come back to this clinical case later.

As Pope's experiments seemed to indicate that sodium citrate solution prevents the primary formation of adhesions, I was interested to determine whether the solution would prevent the reformation of already

existing adhesions after these had been separated or divided. It was with this object in view that this research was begun.

In order to determine this point, the experiments which are detailed below were carried out. Dogs were used for the experiments because I believe their peritoneum probably more closely resembles the human peritoneum than does that of the rabbits. All operations were done with the dogs under ether anesthesia the usual aseptic precautions being observed.

At a primary operation a median laparotomy was performed, and the surface of the gall-bladder and the pyloric end of the stomach were painted with pure tincture of iodine to cause the formation of adhesions. The abdomen was then closed in layers, using a continuous plain catgut suture for the peritoneum, a running chromic catgut suture for the fascia, and a continuous black waxed silk suture for the skin.

That painting peritoneal surfaces with tincture of iodine will cause the formation of firm adhesions is well known (Borst, 2; Heinz, 3). Kausch (4) used this method to produce adhesions between the upper surface of the liver and the diaphragm, between the anterior surface of the liver and the anterior abdominal wall, and between the omentum and the abdominal wall, with success in a case of atrophic cirrhosis with ascites, instead of doing the

¹ Presented in abstract before The Chicago Surgical Society November 5, 1915. (See p. 631.)

Talma operation which he never found entirely satisfactory, and which is more dangerous because of the hemorrhage which not infrequently occurs.

Some time after performing this primary operation to produce adhesions, a second laparotomy was done; the adhesions which had formed were separated, oozing was controlled as well as possible, and then the peritoneum was closed as before. Just before ending the peritoneal closure, however, i.e., just before drawing the last stitches together, the neck of a glass funnel was inserted between the last stitches, which were separated, and were then drawn taut so that the peritoneum was pouched closely about the neck of the funnel. As much sodium citrate solution was now poured into the abdomen as the latter would hold, and then the peritoneal suture was drawn tight while the funnel was being withdrawn, so that none of the citrate solution could escape. Finally, the suture was knotted, closing the peritoneal cavity tightly. The fascia and skin were then closed as described above.

At a third operation, or at autopsy, the abdominal cavity was again opened to note whether the adhesions had reformed and, if so, whether they were less extensive than before.

Dog 1. Operated upon October 19, 1914. The gall bladder and pyloric end of stomach were swabbed with iodine to cause adhesions. Second operation, November 10, 1914. There were adhesions between left lobe of liver and omentum, and left lobe of liver and stomach. A few adhesions between the gall bladder and the omentum. All these adhesions were separated and about 100 ccm of sodium citrate solution introduced. The dog was killed December 1, 1914. Autopsy showed that more adhesions were present than originally. They were very numerous and firm between the gall bladder and the stomach, and between the gall bladder and the liver, also between the liver and the abdominal wall.

The sodium citrate obviously did not prevent the reformation of the adhesions but even seemed to favor their formation.

Dog 2. Primary operation October 22, 1914. The gall bladder and the pyloric end of the stomach were swabbed with tincture of iodine to form adhesions. The abdomen was reopened October 27, 1914. There were no adhesions between the gall bladder and the stomach, though there were some

holding the omentum to the anterior wall of the stomach near the pylorus and to the scar in the abdominal wall. In a second attempt to produce adhesions between the gall bladder and the pylorus, these were again swabbed with iodine and a single stitch of plain catgut inserted to hold them in contact. November 17, 1914, the abdomen was reopened. There were no adhesions between the gall bladder and the stomach, though there were some uniting the omentum to the gall bladder, stomach, and liver. These were separated and then sodium citrate solution was introduced. The dog died January 28, 1915. There were some adhesions between the stomach and the liver but none between the gall bladder and the stomach. The omentum was adherent to the anterior abdominal wall in the operative scar.

Here again the citrate solution failed to prevent the reformation of adhesions.

Dog 3. At a primary operation on November 3, 1914, the gall bladder and pylorus were swabbed with tincture of iodine. Reoperation on November 19, 1914, showed a few adhesions of the omentum to the gall bladder and to the stomach but many to the anterior abdominal wall. The same regions were again painted with iodine and then, just before closing the abdomen, about three ounces of sodium citrate were introduced. Reoperation sometime in December (date not recorded) showed very firm dense adhesions between the anterior surface of the liver and the anterior abdominal wall, and between the omentum and the liver, and dense adhesions between the pylorus and the inferior surface of the liver. These were carefully separated and the abdomen filled with sodium citrate solution. The dog died January 23, 1915. At autopsy the cause of death could not be determined—no peritonitis. There were many firm adhesions between the anterior surface of the liver and the anterior abdominal wall, between the pyloric end of the stomach and the inferior surface of the liver, between the inferior surface of the liver and the duodenum, between the gall bladder and the duodenum, between the omentum and the pyloric end of the stomach and the duodenum.

Here, as in the previous cases, there were more adhesions now than before.

Dog 4. Primary operation November 10, 1914. Tincture of iodine was applied to the gall bladder and pylorus, and a catgut stitch put in to unite them. At a second operation November 24, 1914, adhesions were found between omentum and liver and omentum and gall bladder. The anterior surface of the liver was adherent to the anterior abdominal wall. All these adhesions were separated and sodium citrate solution introduced. The dog was killed December 5, 1914. There were dense adhesions present, and these were much more numerous than at the previous operation, between the anterior surface of the liver and the abdominal wall, between

the liver and the pylorus, and between the gall bladder and the pylorus. In addition, the omentum was adherent to the anterior wall of the stomach, to the gall bladder, and between the lobes of the liver. Indeed, the viscera in the entire right upper quadrant were plastered together.

This only substantiated the former experiments.

Dog 5. Primary operation November 12, 1914, to form adhesions. Second operation December 17, 1914, when sodium citrate was introduced after separation of the adhesions. The dog died December 24, from infection.

Dog 6. Here again the dog died this time the cause of death was not evident. Death occurred during the night after the sodium citrate had been introduced.

As the first four dogs all showed the same findings, i. e., that there were more adhesions after the original adhesions had been separated and the sodium citrate introduced, it seemed clear that sodium citrate would not prevent the reformation of adhesions in dogs under these conditions. The fact that more adhesions were observed after the original adhesions had been separated and the citrate solution introduced may possibly be attributed to the inhibition of coagulation consequent to the physiological action of the citrate solution. In other words the oozing, which regularly follows the separation of adhesions, probably continued to an abnormal degree.

It next seemed interesting to determine whether primary adhesion formation could be prevented in dogs, as Saxton Pope reported in rabbits, using a similar technique.

Accordingly, the following experiments were carried out. At a primary operation the entire peritoneal surface of the large bowel (which is very short in dogs) was scraped with a scalpel till raw and covered with a bloody serum. Then the abdomen was filled with sodium citrate solution and closed as in the previous experiments. After some time had elapsed or when the dogs had died, the abdomen was reopened and examined to see whether any adhesions had formed. Another set of dogs was used as controls. These were treated in exactly the same way, except that no citrate solution was introduced. The results in the citrate dogs were as follows:

CITRATE DOGS

Dog 7. Operated on December 24, 1914. In this dog both the large intestine and an adjacent loop of small intestine were scraped as described above and citrate solution introduced. The dog was killed February 2, 1915. The wound had healed nicely. There was firm fibrous union between the colon and the adjacent loop of small intestine in an area about two centimeters long and 2 millimeters wide. Otherwise the entire large intestine was free from adhesions. However, scars from the previous scraping were seen in a few areas. In other respects the large bowel appeared entirely normal. There were some adhesions between the omentum and the small intestine.

It seemed remarkable that more adhesions had not formed considering the extent and degree of the trauma. The next case was even more striking.

Dog 8. Operated on January 8, 1915. The entire large intestine was scraped as in the previous experiment and citrate solution introduced. The dog was killed February 2, 1915. There were absolutely no adhesions. The large intestine looked quite normal.

The sodium citrate solution apparently seemed to be of considerable value, but a control dog operated on the same day in exactly the same manner, except that no citrate was introduced, showed practically as complete absence of adhesion formation. This will be referred to later.

Dog 9. Operated on January 25, 1915. The colon was scraped until raw, then abdomen was filled with citrate solution and closed. On February 2, the dog was killed as the wound was open externally, and it was desirable to see whether any adhesions had formed before the wound might open entirely and peritonitis develop. Two very small and slight adhesions were present between the free surface of the colon and its mesentery — practically no change whatsoever.

Dog 10. Primary operation January 16, 1915. The colon was scraped, and citrate introduced. The dog died January 28. There were no adhesions. No peritonitis.

Dog 11. At primary operation January 19, 1915, both the large intestine and an adjacent loop of small intestine were scraped and then citrate solution introduced. The dog died February 18. The cause of death could not be determined. There were no adhesions and no peritonitis.

Dog 12. January 25, 1915, the colon was scraped until raw and citrate solution was introduced. As the wound was opening externally, the dog was killed February 2, 1915. There were very slight adhesions in two places between the free surface of the colon

and the mesentery of the colon. No other adhesions.

Dog 13. January 26, 1915, the colon was scraped until raw and citrate solution then introduced. The dog was killed February 23. There was one adhesion between two portions of the colon which was bent on itself, also an adhesion between the colon and an adjacent loop of small intestine.

In this dog again the citrate did not prevent adhesions.

Dog 14. January 26, 1915, the colon was scraped until raw and sodium citrate introduced. The dog was killed February 23. There was some thickening and scar like discoloration on the free surface of the colon but no adhesions. The abdominal wound was well healed.

Dog 15. May 11, 1915, the colon was scraped until raw and then sodium citrate was introduced. The dog had no appetite following the operation, seemed sick, and died May 15. Post-mortem showed no adhesions, though the small intestine exhibited some redness (peritonitis?), however, the serosa was shiny and there was no fibrinous exudate. The lungs showed marked congestion of all lobes.

Dog 16. Primary operation May 17, 1915. The dog was killed May 25. There were dense adhesions between the colon and an adjacent loop of small intestine. Also the omentum was adherent to the colon. The skin incision was not entirely healed, but there was no peritonitis.

Here again the citrate solution failed to prevent the formation of adhesions.

Dog 17. Primary operation May 17, 1915. The dog was killed May 25, as the wound in the abdominal wall was not entirely healed and in one place had opened almost down to the peritoneum. There was localized peritonitis with adhesions of the small intestine through the colon and to the anterior abdominal wall. These adhesions were perhaps secondary to failure of the abdominal incision to heal resulting in peritonitis from infection from without. This could not be determined with certainty, however.

Dog 18. Operated on May 18, 1915. Killed May 25, 1915. The skin incision was not well healed, but the peritoneum was well closed and no peritonitis had developed. The omentum was adherent to the colon for almost its entire length.

Here again the citrate failed to prevent adhesions from developing.

Dog 19. Died of pneumonia two days after the operation and therefore was of no value.

As controls the following dogs were used. They were treated in the same manner as the citrate dogs except that no sodium citrate solution was introduced.

CONTROL DOGS

Dog 20. Operated on January 7, 1915. The dog died January 17 from peritonitis due to partial opening of the wound. There were no adhesions.

Dog 21. Operated on January 8, 1915. The dog died January 17, from peritonitis, the wound having opened partially. While there were some adhesions between the colon and the great omentum there were none between the large intestine and the small intestine.

Dog 22. Operated on January 19, 1915. Died February 23. The cause of death could not be determined. There were slight adhesions between the colon and two separate loops of small intestine.

Dog 23. Operated on January 19, 1915. Died February 18, 1915. There was not the slightest trace of any adhesion formation.

Dog 24. Operated on February 23, 1915. Killed March 5. One loop of small intestine adherent to the large bowel. Also some adhesions of the omentum to the large bowel.

Dog 25. Operated on March 5, 1915. Killed March 5. There were very few adhesions between the omentum and colon, none between the small intestine and colon.

Dog 26. Operated on April 13, 1915. Killed May 4, 1915. There were some adhesions between the omentum and colon. One very slight adhesion between colon and one loop of small intestine.

Dog 27. Operated on April 13. Killed May 4, 1915. There was one marked and extensive adhesion between the colon and a loop of small intestine. The omentum was adherent to the colon in several places.

Dog 28. Operated on April 19. Killed May 4, 1915. There were marked and very dense adhesions between the omentum and the colon, and between the colon and one loop of small intestine.

Dog 29. Operated on April 20. Killed May 4, 1915. There were extensive adhesions between the colon and two loops of small intestine, moreover, the colon was adherent to the bladder and the omentum to the colon. The incision was perfectly healed and there was no peritonitis.

Dog 30. Operated on May 3. Killed May 17, 1915. There was adhesion between the omentum and the colon in a small area, also one firm adhesion between the colon and one loop of small intestine.

Dog 31. Operated on May 4. Killed May 18, 1915. The omentum was adherent to the colon almost the entire length of the latter. One small but firm adhesion was present between the appendix and a loop of small intestine.

Comparison of the results in the citrate dogs with those in the controls showed that, in both sets, some animals exhibited adhesions whereas others showed none. Indeed, on opening the dogs the second time, one could not tell the citrate dogs from the controls, as there was no marked difference, though, on

the whole, the control dogs showed somewhat more adhesions than did the citrate dogs. One gained the impression that the citrate was of relatively little value, if any at all, in preventing the formation of adhesions.

That a single, severe, mechanical trauma to the peritoneum, even though extensive, is an uncertain means of provoking the formation of adhesions was observed years ago, as may be learned from the experiments reported by Kelterborn (5), Dembowski (6), Vogel (7), Duschinsky (8), etc. This is now so generally recognized that the more recent workers have come to use other aseptic means of producing adhesions, chiefly chemical, as tincture of iodine (Borst, 2, Heinz, 3), Lugol's solution (Heinz), pulverized metallic magnesium (Payr-Schmiedt, 9 and 10), etc. Schmiedt (10), in a very recent study, used all three of these methods and these only.

Sweet, Chaney, and Wilson (11) in an article on "The Prevention of Post-operative Adhesions in the Peritoneal Cavity," among other substances studied the effect of sodium citrate solution in a series of seven dogs. Instead of using the solution recommended by Pope (2 per cent sodium citrate solution in 3 per cent sodium chloride solution) they employed a 3 per cent sodium citrate solution in normal salt solution. In each of the seven dogs, end to end entero-enterostomies were performed at two points, and then, just before closing the abdomen, 50 ccm of sodium citrate solution was introduced. One dog died from peritonitis four days after the operation. In another dog the abdominal incision split open on the third day after the operation and the dog had to be killed. In the other five dogs "general adhesions" were present of the omentum to the gut in the neighborhood of the operative areas, and between the original loops of intestine to a considerable extent. "In no instance was there perfect healing of the abdominal wound, a distinct contrast with the former cases" (in which they used other substances to prevent adhesion formation). They state farther "Our results with the use of citrate solution in dogs are just opposite from the results which Pope obtained with the same solution in rabbits." (As pointed out above,

however, the solution was not exactly the same.) They believe the disagreement between their results and those of Pope "may be due to the fact that he did his work on rabbits, the peritoneum of which is generally known to be very resistant to infection, and that he was working under the artificial condition of the exclusion of possible infection." They believe, further, that the citrate solution "limits the normal production of plastic lymph so that seepage takes place through the lines of intestinal suture and a minor degree of infection follows which results later in the production of adhesions, though there is not enough infection present in all cases to give a definite peritonitis." They end by stating that "while we are not inclined to draw final conclusions, we would say that citrate solution is not indicated in cases where infection may be present."

To make further observations on this point, I operated on a series of dogs as follows: An intestinal resection was done, and after closing each of the ends by the Dojen method, a side-to-side entero-enterostomy was performed, and the abdomen was filled with 2 per cent sodium citrate solution in 3 per cent sodium chloride.

Doc 32 Operation performed March 8, 1915. The dog died on the second day from distemper pneumonia. There was no leakage and no peritonitis.

Doc 33 Operation performed March 9, 1915. The dog died March 17 from distemper pneumonia. At autopsy, the anastomosis was found to be water tight, there had been no leakage and no peritonitis. However, there were some adhesions of the omentum to the gut at several points about the site of the anastomosis.

Doc 34 Operated on March 22, died March 28, of peritonitis due to the fact that the wound in the abdominal wall had broken open.

Doc 35 Operation performed March 26. The dog was killed April 10. The anastomosis was perfect. The abdominal wound was well healed. There were some adhesions of the omentum to the site of anastomosis but no adhesions between the intestines.

Doc 36 Operation performed March 30. The dog was killed April 21. The anastomosis was perfect. There was no leakage and no peritonitis. There was a very slight adhesion of the omentum at one point to the site of the anastomosis.

Although my results were better than those of Sweet, Chaney, and Wilson, referred

to above, in that I did not have any leakage in any of my cases, and in no case had any adhesions between adjacent loops of small intestine, nevertheless, with the exception of the case that died on the second day from diphtheria pneumonia, there were adhesions between the omentum and the intestine, at the site of the anastomosis, in every case.

Pope specifically states that "it is not assumed that citrate solutions will prevent adhesions where large denuded areas of the peritoneum are exposed . . . that these laboratory results seem applicable only as a mild preventive during abdominal operations, which ordinarily tend to leave more or less agglutination and troublesome post-operative adhesions," and he does "not suggest that large quantities of the solutions be left in the abdominal cavity," but "that the usual operating room solutions of normal salt have added to them a 1 or 2 per cent of citrate of soda."

To determine whether a substance prevents adhesion formation, however, is difficult unless one has controls, and in clinical work of course we have no controls. In my dog experiments it was surprising what extensive scarification could be accomplished without any adhesions forming, and how few and slight the adhesions were where an extensive area was denuded. It was for this reason that such extensive traumatism seemed necessary in this work.

In regard to the amount of sodium citrate solution used it should be stated that Pope in his experiments introduced one-half ounce into the peritoneal cavity of rabbits, whereas in these experiments on dogs, as has been stated, as much was introduced as the abdominal cavity would hold. And it is difficult to understand how much could be expected from the use of a very small quantity of the solution, as a small quantity would probably be absorbed before it could exert much effect. Even when larger amounts are used, it is a question whether absorption does not occur before much effect could be expected. Graser (12), in a careful study on the development of peritoneal adhesions, found that the damaged serosa epithelium required 4 to 6 days to regenerate. Theor-

etically, therefore, any substance which is introduced into the abdominal cavity to prevent the formation of adhesions, to be thoroughly efficacious, ought to remain at least 4 days. Schmiedt's experiments with hirudin would seem to substantiate this. He found that he had success only in animals in which he injected hirudin into the abdominal cavity daily on 4 or 5 successive days. Pope, in his rabbit experiments, found that the citrate solution he introduced remained in the peritoneal cavity only 48 hours, however.

If a practical technique could be devised whereby one could inject the citrate solution repeatedly, and if enough were injected on successive days to keep the peritoneal surfaces constantly bathed with the solution for 4 to 6 days, possibly then the results might be more uniform.

Before closing, I wish to report the *human* case in which I used the sodium citrate solution. Just ten days after I had begun this research, I had a clinical case in which the conditions seemed to justify the use of sodium citrate solution, even though so little work with it had been published up to that time. This case is interesting not only because sodium citrate was used to prevent the reformation of adhesions, but also because this was the patient's third operation for acute intestinal obstruction from adhesions, and the patient's fourth laparotomy. The primary operation was for acute gangrenous appendicitis with general peritonitis, and this produced the adhesions caused the subsequent attacks of strangulation ileus.

The patient, M. M., a boy, 14 years of age, Michael Reese Hospital, Numbers 56,835, 62,932, and 73,235, first entered the hospital during an attack of acute appendicitis, with general peritonitis August 24, 1912, operation by Dr. D. N. Eisendrath, appendectomy through a right pararectal incision. On opening the peritoneum a very fetid, yellowish-green pus escaped from all directions. The cecum showed marked evidences of beginning peritonitis, and all visible coils of small intestine were markedly injected and showed roughened serosa. The appendix was retrocaecal, its tip was firmly bound down and gangrenous, as was also the adjacent portion of the outer half of the cecum. After the appendix was removed, in order to prevent hemorrhage from its bed, a strip of plain gauze packing was inserted, the end of which was brought out through a separate stab wound at the outer side of the original

incision. The pelvis was drained by means of a tube inserted through a small suprapubic incision. The patient made an uneventful recovery and was discharged September 11, 1912.

He remained perfectly well until July 13, 1913, when he developed the typical symptoms of acute intestinal obstruction, and entered the hospital on Dr. Emanuel Friend's service. Immediate laparotomy was performed through a right rectus incision. Exploration of the abdomen showed, at the site of the old scar, adhesions of the cecum to the abdominal wall. The point of obstruction was found near the lower ileum, where a single adhesion completely constricted the intestine, the portion below being collapsed and that above dilated. After dividing and ligating this band, two rows of Lembert sutures were inserted in the gut to cover over the denuded area of the gut which the band had produced. The intestines were so distended that it was necessary to insert a trocar to relieve the distention. The hole in the bowel thus formed was closed by a purse string suture, re-enforced by a few Lembert sutures. The recovery was uneventful, except for a small slough which developed in the middle of the wound. This cleared up rapidly, however, and the boy was discharged August 3.

He remained in good health until October 15, 1914, when he was again taken ill with acute intestinal obstruction, and entered the hospital on Dr. L. L. McArthur's service. Immediate laparotomy was performed by Dr. McArthur through a curved incision made slightly medially to the old pararectal scar. On opening the peritoneum no bowel was found adherent to the abdominal wall. On careful exploration, a loop of small bowel, 10 to 12 inches long, was found strangulated by an adhesion located about 16 inches from the ileocecal valve. The gut was dark red in color and two thrombi were present in the arteries of its mesentery. The adhesion was doubly clamped, divided, and ligated. In a short time the color returned in the strangulated loop. No bleeding points were seen. The abdomen was closed in layers.

The patient was up in a wheel chair October 25, 1914, and was discharged October 29, 1914. Just as he was about to leave the hospital, however, he suddenly developed typical symptoms of acute ileus. Dr. McArthur kindly turned him over to me for operation, and suggested that this might be a good case in which to try the sodium citrate solution. Through an incision about three-quarters of an inch to the mesial side of the recent scar, I opened the abdomen and found a small adhesion strangulating a portion of the small intestine against the posterior parietal wall, just above and opposite the site of the recent incision. The bowel above this band was distended and the portion below it collapsed. The band was treated in the usual manner. Another adhesion was seen holding the bowel to the anterior abdominal wall at the site of the recent scar. This was likewise clamped, divided, and ligated. After all bleeding points were clamped and

ligated, 250 ccm. of 2 per cent sodium citrate in 3 per cent sodium chloride solution was introduced and the abdomen closed in layers, using a continuous plain catgut suture for the peritoneum, a continuous No. 2 chromic catgut suture for the fascia, and a continuous black waxed silk suture for the skin. In addition, three tension sutures of No. 5 black waxed silk were used. As soon as the citrate solution was introduced the patient's respiration suddenly became very deep and slow, but soon returned to normal. He made an uneventful recovery. When discharged from the hospital November 27, 1914, he said he had some pain near the wound. This I believed, from his description, was due to an adhesion. He has remained well and when last seen, January 22, 1916, he was entirely free from any abdominal discomfort and felt perfectly well.

Although I used sodium citrate in this case, and the patient made an uneventful recovery, I do not feel that the recovery can in any way be attributed to the use of sodium citrate solution. If this case had come to me after I had finished the animal experiments above described, I should not have used the citrate solution.

In conclusion, I might summarize my impressions of the value of sodium citrate in dogs as follows. Sodium citrate solution is of no value at all in preventing the reformation of adhesions which have been separated. Sodium citrate solution is of little value, if of any at all, in preventing the primary formation of adhesions, and may interfere somewhat with wound healing.

NOTE—Since the above paper was submitted for publication, two new articles have appeared on this subject, one by M. H. Waller and L. M. Ferguson (13), and one by Saxton Pope (14). These authors come to quite different conclusions as to the value of the citrate solution, than I found in dogs, though these observers did all their experimental work on rabbits. In neither of these articles do the authors refer to the poor results reported by Sweet, Chaney, and Wilson, who, as I, did their experimental work on dogs. Perhaps this may explain the discrepancy in the results.

Waller and Ferguson state that, "scratching the colon in many places over its proximal two or three inches, the scratches going through the serosa down to the submucosa, invariably caused firm adhesions," but they do not state in how many animals this was tried. They state further, "this technique—being easily duplicated and sure in its results" was used in all the experiments they reported. They do not, however, offer evidence to substantiate this statement that this technique is sure in its results. It is unfortunate that they failed to state the number of control animals used, for, without knowing the result in an equal number of control rabbits, it is difficult to determine the real value of the citrate experiments. Their statistics

show that there was a total absence of adhesions in only 17 of their 40 experiments tabulated.

Pope, in his recent article, admits that the citrate interferes somewhat with wound healing. He says, "The abdominal wounds do show more oozing during closure, but in no case has it seemed to lead to failure of union nor to post-operative bleeding."

Ten of his 400 human cases came to reoperation, and he reports that there was "marked improvement in all but 3 cases" though he admits that, "it is very difficult to judge the evidence thus afforded." It would be interesting to know how long after the primary operation these cases were seen for the second time, because this is an all important point. As is well known, cases where adhesions are known to have existed, may, after the lapse of some time, show no adhesions whatsoever. Therefore, in this work on adhesions, the time element must be known, before one can interpret observations.

Pope, finally, states that we have convincing experimental evidence. I do not believe that the relatively small number of experimental and clinical cases reported by all workers, added together, can be considered sufficient evidence to prove such a question conclusively, and where different observers are divided in their findings, as in this case, the experimental evidence is not convincing. I believe a great many more observations will have to be made before we are justified in drawing final conclusions.

BIBLIOGRAPHY

- 1 POPE, SAXTON. *Ann Surg, Phila*, 1914, lxx, 101.
- 2 BORST. *Physikal-med. Gesellsch. zu Wuerzburg*, 1897, xxxi.
- 3 HEINZ. *Muenchener med. Wchnschr*, 1900, xlvii, 213, 1901, xlviii, 585, *Virchow's Arch*, 1899, clv, 44.
- 4 KAUSCH. Discussion of paper by Rothstein. *Verhandl. d. deutsch. Geschellsch. f. chir.* xli, Kong., 1912, p. 206.
- 5 KETTERBORN. *Zentralbl. f. Gynaek*, 1890, xiv, 913.
- 6 V. DEMBOWSKY. *Arch. f. klin. Chir.*, 1888, xxxvii, 745, *Zentralbl. f. Gynaek*, 1891, xv, 281.
- 7 VOGEL. *Deutsche Ztschr. f. Chir.*, 1902, lxxii, 296.
- 8 DUSCHINSKY, M. *Experimentelle Untersuchungen ueber die Vermeidung von Adhaesionen nach Laparotomien*. Inaugural Dissertation, Muenchen, 1898. Quoted by Schmiedt and earlier writers, as Vogel.
- 9 PAVR. *Deutsche Ztschr. f. Chir.*, 1902, xlii, 503.
- 10 SCHMIEDT. *Arch. f. klin. Chir.*, 1914, civ, 1031.
- 11 SWEET, CHANEY, and WILSON. *Ann Surg, Phila*, 1915, lxi, 297.
- 12 GRASER. *Deutsche Ztschr. f. Chir.*, 1888, xxvii, 533, *Arch. f. klin. Chir.*, 1895, l, 889.
- 13 WALKER, M. H. JR., and L. M. FERGUSON. *Ann Surg, Phila*, 1916, lxxii, 198.
- 14 POPE, SAXTON. *Ann Surg, Phila*, 1916, lxxii, 205.

DEPARTMENT OF TECHNIQUE

THE HETEROGENOUS INTRAMEDULLARY BONE-PEG; ITS POSSIBILITIES AND LIMITATIONS

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THE remarkably large number of recent articles dealing with the problem of the open repair of fractures is a graphic sign of rebellion against the Lane, Lambotte, and other less popularized methods having for their basis the use of non absorbable material. While fully recognizing the great progress in the treatment of irreducible fractures of the long bones, which these methods have enabled us to accomplish, surgeons have gradually been forced to the conclusion that non absorbable material seriously jeopardizes the end results of their operative cases. It is manifestly impossible for any operator or institution to state what percentage of open fracture cases has had to have a Lane plate, wire, or screws removed after union has taken place. Individual experience teaches us that this class of cases almost always migrates from one clinic to another. That the percentage of such secondary work is large, is my firm belief. Those of us who have been fortunate enough to watch the *modus operandi* of Lane or Lambotte, must however recognize the fact that in all recent modifications of our procedure, the mechanics and aseptic technique of these men still forms the basis of our work.

The controversy over the respective functions of bone and periosteum remains as lively and as healthy as ever, the probabilities being that we are needlessly splitting hairs. What is much more important, to my mind, is the ultimate fate of any and all transplants. If an autogenous transplant lives permanently, its superiority over heterogenous living or dead (sterile) transplants leaves no room for controversy. Murphy states that "the transplant, no matter how small or how large it may be, is always absorbed." He considers all bone grafts as merely osteoconductive. Oechner of New Orleans inclines to the belief that long-bone transplants are dependent for their success upon (a) the mechanical support of the bone itself, (b) the physiologic

element of regeneration as conveyed by its periosteum, endosteum, and osteoblasts. Without adducing any experimental or clinical data, he then makes the statement that "for the present, a thorough applicability of heterogenous grafts has not been established." Phemister's experiments would tend to prove that the majority, if not all, of the cells of a transplant, with or without periosteum, fresh or boiled, ultimately undergoes necrosis and absorption. Davison and Smutb are positive that transplants are not permanent entities and that they are eventually absorbed. It would therefore appear that, while living autogenous grafts with their periosteum, conduce to more rapid repair of fractures, and are probably indispensable in reconstructing bony defects, they nevertheless finally disappear. It takes time to obtain an autogenous graft, thereby lengthening the operation, increasing traumatism and, as recently reported by Dyas, a pathologic fracture of the tibia deprived of its crest is a possibility which must be borne in mind. The use of a portion of the fibula, as advocated and practiced by Davison, has decided advantages over the tibial transplant. A heterogenous graft, on the other hand, is always obtainable at any meat market, can be easily cut into the required length and thickness, is sterilized by boiling and keeps for months without becoming too brittle.

I began the use of sterile soup-bone intramedullary splints following the fracture of a fibula splint which I had used in a transverse fracture of the femur. The patient was not willing to sacrifice his remaining fibula, but consented to the use of a heterogenous peg. The result obtained in this case encouraged me to continue along the same lines.

PREPARATION OF THE SPLINTS

Any of the long bones of a steer will answer the purpose. For repair of a femur, the splint

should be four inches long for transverse fractures, five or even six inches for very spiral or comminuted fractures, and approximately one-half inch in diameter, for the tibia or humerus, four inches long and from one-third to one fourth inch in diameter. While a circular saw and lathe cutter give the peg a more cosmetic appearance, I have found an ordinary hand saw, chisel, and mallet sufficient. The splint is denuded of its periosteum, cut to the proper size, and boiled two consecutive days for two hours and one hour just before the operation. At the time of the operation, it has been my custom to fit the peg to the medullary canal and not to drill the canal to fit the peg. The mechanics and asepsis of Lane are strictly adhered to in every respect.

CASE 1. M N, No 555 525 entered Cook County Hospital December 25 1914. While getting on a street car, the patient lost his balance and fell to the street, landing on his left knee. His left thigh became immediately and completely disabled and he was brought to the hospital in an ambulance. Examination showed a marked deformity of the left thigh, six inches above the knee with visible bulging at the outer part of the lower end of thigh caused by the upper fragment. There was three inches shortening. The skiagram taken on admission showed a transverse fracture of the lower third of the femur the proximal fragment being upward and outward. Attempts at reduction were not successful.

First operation performed December 28 1914. Usual preparation of entire limb with iodine. A five inch incision was made along the outer border of the left leg down to the fibula four inches of which was resected with its periosteum. This was laid in sterile salt solution and a six inch incision over the lower third of the left thigh was next made down to the bone. The fragments were delivered bent at right angles, the edges were freshened and the primary clot removed from the medullary cavities. The fibula peg, trimmed to measure was driven into the distal fragment for two inches and the remaining two inches fitted into the proximal shaft without any special difficulty. The incisions were closed with Michelin clips without drainage, and a pelvis to toes cast applied. Both wounds healed *per primam*, the clips being removed through fenestra six days later. Six weeks later the cast was removed when motility and crepitus were obtained at the site of the fracture. The limb was again immobilized for five weeks but motility of the fragments persisting the patient was sent up for another skiagram which showed a transverse fracture of the peg. This accident must have happened while the cast was being applied. The patient very much discouraged, refused to have his right fibula sacrificed but consented to the use of a soup bone peg. On March 22 1915 the thigh incision was reopened the broken fragments of the fibula pulled out the edges of the fracture freshened and a four inch soup-bone peg introduced. The wound was closed without drainage and a cast applied under my direct supervision. The result (see Fig 1) was excellent healing *per primam*. The cast was removed May 22. Union was firm with a large amount of callus. Patient began the use of crutches May 9 and left the hospital June 25. A skiagram taken June 26 shows a large callus with apparently a beginning absorption of the bone peg the outline of which is much fainter than in the previous skiagrams.

CASE 2. A K, No 557 543, entered Cook County Hospital January 20, 1915. The patient stated that he fell down a flight of stairs, but does not know how he landed. He suffered immediate disability in the right lower limb. On examination at the hospital, an angular deformity of the right thigh between the upper and middle thirds was found, the upper fragment being strongly abducted. There was a shortening of three inches. The entrance skiagram taken shows an irregular oblique fracture, five inches below the superior border of the great trochanter on the outer side. The upper fragment was anterior, with an outward and upward retraction of the lower fragment of three inches. Attempts at reduction having failed, the patient was operated upon January 25, 1915. Usual preparation. External femoral incision six inches long beginning near lower border of great trochanter. The edges of the fracture were freshened, the medullary cavities cleansed of the primary clot and a five-inch soup-bone peg driven into the upper fragment for a distance of three inches. By traction and angulation the distal canal was brought into alignment and the peg slipped in easily. The wound was closed without drain. *etc.* A Whitman abduction cast should have been applied in this case instead of the ordinary one, and the cast, in view of the patient's age (65), should have remained on for at least ten weeks. Owing to the routine change of interne service, with its incident confusion, the cast was removed March 4 and a Hamilton splint applied. A skiagram taken March 16 shows that the peg has partly slipped out of the distal medullary cavity, allowing angulation to occur. Measurements taken at that time showed a bare half inch shortening. As the patient was a poor surgical risk, a second operation or refracture of the femur was decided against. Firm bony union occurred patient leaving the hospital June 28. I am convinced that a Whitman abduction cast, maintained for ten weeks, would have given us perfect anatomical as well as functional results.

CASE 3. P A, No 557 80r, entered Cook County Hospital January 23. The patient had slipped on the sidewalk and fallen on his left leg, which at once became totally disabled. Examination showed angulation with abduction and eversion of foot and lower third of leg. There was a shortening of one half inch. The first skiagram did not reveal the fracture of the fibula which was in its upper third neither was it satisfactory as regards angulation and outward rotation of the lower fragment. Several attempts at reduction having failed the patient consented to an open operation which was performed February 1. Usual preparation, incision and exposure of fragments which were angulated and freshened the medullary clots curetted out and a four inch soup-bone peg introduced. Closure without drainage, plaster cast applied from the middle of the thigh to the toes. The cast was fenestrated and chips removed six days later when a superficial stitch abscess was found which healed rapidly. The cast was removed March 22. The final skiagram shows the bones and peg in excellent position. There is a rather large amount of callus present several areas of which do not appear to be calcified. No shortening on measurement. The patient left hospital March 27, able to walk with the aid of a cane.

CASE 4. Communited fracture of right femur lower third. Mrs L W, age 46 entered Cook County Hospital June 18, 1915. Through the courtesy of my colleague, Dr Paul Wolf I was allowed the privilege of operating on this case. Repeated attempts at reduction had already been made, all had failed. The first skiagram taken shows a comminuted fracture of the lower and middle third of the femur with outward and backward displace



Fig. 1. Skelgram showing the excellent result in Case 1.

ment of the fragments. A spicule of bone is seen in the distal medullary canal and the proximal fragment is displaced medially fully an inch. Operation July 9. Usual preparation and tourniquet over the lower third of the femur. A number of small spicules were removed together with the first one in the medullary canal. It was then noticed that both the proximal and distal portions of the shaft were suited for a distance of two or three inches. The soap-bone peg, which had been prepared for this use, is only four inches long. It should have been five or six inches long in order to hold the shaft in good apposition. A satisfactory apposition of fragments was extremely hard to obtain. The incision was closed without drainage and a body thigh leg cast applied. A skelgram taken on the full recovery day shows complete reduction with the largest portion of the peg in the lower fragment, the upper portion is in the medullary canal but does not entirely fill same so that apposition is not entirely complete. Infection of a moderately severe degree occurred and the cast was removed. The splints and traction which replaced it failed to prevent angulation. The patient left the hospital September 5, promising to return in two months for final disposition of her case. At the time of her departure the infection had entirely cleared up but there is only slight attempt at repair and the angulation persisted.



Fig. 2 (at left). Skelgram made on entrance of patient in Case 5.

Fig. 3. Skelgram showing perfect coaptation in Case 5 after operation.

In view of the comminuted condition of the femur, it is questionable whether a good result could have been obtained under any line of treatment. Nevertheless this case must be classed as an operative failure.

Case 5. F. H. age 40, No. 573,510, the patient did not remember how the accident happened as he was intoxicated at the time. On examination a transverse fracture of the left femur five inches above the knee was found the proximal fragment being anterior to and overhanging the lower fragment by about two inches. The entrance skelgram (see Fig. 2) fails to show the full extent of the shortening. Reduction under ether anesthesia having failed the patient was put up again August 1. Usual preparation and incision along outer side of femur. The fragments were freshened the periosteal sheaths removed from the medullary canals after anastomosing the fragments and a four inch long soap-bone peg is introduced by the usual technique. Closure of wound without drainage. Straight body thigh leg cast applied. Coaptation was perfect (see Fig. 3). Chaps removed seven days later healing per primam. Cast removed October 10, firm bony union present no shortening. Patient left the hospital October 10. He will return once in three months and have further skelgrams taken to ascertain the length of time necessary for absorption of the peg.

Case 6. J. R. age 32, No. 54,348, entered Cook County Hospital August 10, 1915. Seven days prior to admission the patient slipped and fell on the street striking his left hip. He was unable to walk after the accident but remained at home in bed until brought to the hospital. On examination no deformity or swelling was visible. doubtful crepitus could be obtained on a stating

the femur in the region of the neck. There was extreme tenderness on pressure over the great trochanter and one centimeter shortening was demonstrable. The entrance skiagram showed a typical fracture of the neck of the femur. On August 16 he was anesthetized a short incision made over the great trochanter, traction and abduction applied, and two ten penny nails were driven through the trochanter into the head of the femur. The usual body-to-toes cast was applied. The second skiagram shows the general position to be good. Healing of the wound *per primam*. The cast was removed October 11, at which time it was found that no union had occurred. A skiagram shows necrosis of the upper third of the head to have occurred, the nails now lying free in the acetabular cavity. On October 21, I again operated upon the patient using Albee's technique. Through the vertical incision along the inner border of the sartorius muscle and after separating the rectus and psoas as advised by Albee, I was able to get a very good view of the line of fracture. I then reopened the incision over the trochanter and removed the two nails. By means of a hand drill supplemented by a small concave chisel I made a canal approximately one-fourth inch in diameter extending from the trochanter to the margin of the articular surface of the head. The depth of the canal was measured accurately and a piece of soup-bone of same dimensions was prepared and hammered in place. When fitted it was found that the shaft and head of the femur moved as one piece. The fascia was coated by means of interrupted catgut and the skin closed likewise with catgut stitches. Abduction cast applied. Wounds have healed *per primam*. The skiagram (see Fig. 4) shows the peg is not squarely in the center of the head, but the result should be excellent.

CONCLUSIONS

While realizing that the presentation of six intramedullary soup-bone peg cases cannot be considered as conclusive of its merits, I present

¹ Ann Surg 1915, 1915 July



Fig. 4 Skiagram showing position in peg in Case 6

this preliminary report in the hope that it may stimulate further effort along the same lines. The results thus far obtained certainly warrant a more extensive trial of the same heterogenous material.

THE TECHNIQUE OF A NEW PROCEDURE FOR SUBTOTAL ABDOMINAL HYSTERECTOMY IN CASES OF UTERINE FIBROMA OR INFLAMMATION OF THE ADNEXÆ

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UTERINE fibroma and inflammation of the adnexa are frequently met with by the gynecologist and necessitate intervention. The technique of abdominal hysterectomy has been so perfected during the past twenty years that preference is given to the methods insuring the best results, in the shortest time, by the simplest technique. For a long time I have performed hysterectomy successfully by the technique described by Turner, Richelot, Doyen, Pozzi, Javle, Kelly, Kelly-Segond, and J. L. Laure. Except in inflammatory conditions or where there is a tumor involving the cervix, it is my experience that a subtotal abdominal hysterectomy is preferable, and herein I agree with the views generally expressed by surgeons.

It may be of interest to describe the technique I have been using for some time past. It is presented not as an original procedure but rather as an improvement over the other method in that it is a combination of the different methods I have used or have seen used by the various European gynecologists. It is founded on an anatomical basis and its simplicity justifies its presentation to my colleagues.

Figure 1 is a modified reproduction of a drawing from Laure and Syrodek showing the vascular system of the female pelvis and its relation to the ureters. Between the paritoneal folds the uterus receives three groups of vessels. From above downward these are the ovarian, those connected with the round ligament, and the uterine. The latter at the uterine end turn sharply at right angles and encircle the ureter at a distance of one and a half centimeters from the point where the vagina bends back over the cervix, forming the lateral cul-de-sac. From here the uterine vessels ascend to the uterus and upon its lateral wall join the ovarian vessels. It is evident from this description that one ought to be able to control all of this circulation with one forceps provided the end of the forceps grasps the uterine vessels at a point directly above the ureter. The method I shall describe is based upon this fact. The steps are as follows:

1. *Median laparotomy incision*
2. With a tenaculum or hysterolab the fundus is pulled as high as possible and then flexed forward toward the pubis as if it were to be delivered from the abdomen. The assistant now



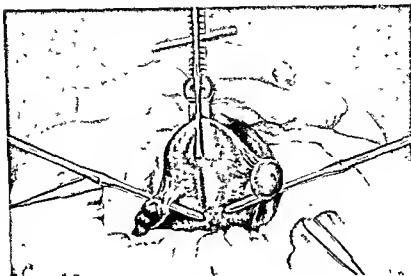


Fig 2

cares for this while the surgeon examines the uterus and adnexa, and pushes down the bladder so as to bring it and the ureters close to the pubis. The broad ligament is stretched out and brought within reach. The thumb and index finger of the left hand grasp the broad ligament just outside the adnexa and seek the cervix through the walls of the vagina, ascending slowly from there to the point where the beating of the uterine vessels can be felt. This is the point where this

artery crosses the ureter. The right hand now seizes a strong long forceps with flexible points and compresses the area covered by the thumb and index finger of the left hand.

3. *The whole breadth of the broad ligament is thus compressed above the points of the forceps which touch the borders of the cervix. The forceps are slowly but tightly locked to completely close the three arteries of the uterus and to fix the two layers of the broad ligament in a constant*

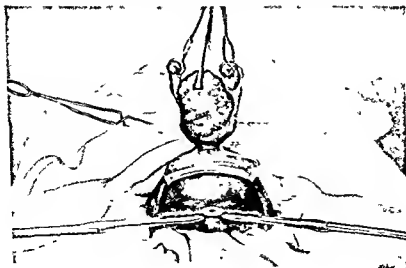


Fig 3



Not a single drop of blood need therefore be lost, an advantage in patients weakened by hæmorrhage.

3 The two strong forceps fixed on the broad ligaments from the beginning of the operation insure the compression of the arteries, allow the cutting of both layers at the same level and at the same time, and prevent any blood from accumulating between the remaining parts of the layer. That the peritonization is so easy by this method is due, partly to the manner in which the suture is made, and partly to the fact that the ligature of the vessels and the peritonization are made simultaneously.

4 The value of my method from an anatomical point of view consists in the fact that care is taken to compress the ligaments with the two forceps from the beginning of the operation and to avoid injuring the bladder and the ureters.

Professor Pauchet at Amiens who has used my method emphasizes the following advantages

The advantageous fixation of the cervix. It often happens that the vaginal wall prolapses after total or subtotal hysterectomy, because the cervix is no longer supported by the ligaments and therefore has a tendency to sink. Thanks, however, to the peculiar suture used in my method which unites the remaining parts of the ovarian arteries, the round ligament, and the cervix, a solid stem is formed by the peritoneal wall and these different parts which is capable of preventing the sinking of the cervix.

This method therefore is the preventive treatment against cystocele so well known to every gynecologist, it is the ligamentopexy of the cervix.

As the forceps are still compressing the ligaments when the peritonization is made, this procedure becomes an easy matter even in obese patients, in patients who are restless during the operation, or in patients who have exceptionally short ligaments.

AN IMPROVED TOWEL CLIP

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THE need of a clip to fasten the lap sheet or towel to the edge of the wound and thus reduce the chances of infection from or to the skin has led to the invention of various instruments

not allowing twisting of the skin by being bent over to one side as has occurred in other models in which the handle has been at right angles with the abdominal wall.

The handle may be straight as in the figure or



The clip shown in the figure is a modification of previous instruments and has been devised to overcome some of the objections to the clips now in use. The salient features are a handle which will lie flat against the abdominal wall and which will

slightly curve to adapt itself to the average curve of the abdomen. The lock and shape of the finger holes is such that the chances of catching ligatures, etc., about the handle are reduced to a minimum.

DYSTOCIA DUE TO ASCITES IN FÆTUS WITH PERSISTENT CLOACA

REPORT OF CASE

By KENNETH M. LYNCH, M.D., and ALLEN J. JAFFA, M.D., Charleston, South Carolina

ON October 5, 1915, one of us (A. J. J.) was called in consultation in a labor case as follows: The patient was an Italian woman, age 16, with negative family and personal history. Her first pregnancy, one year ago, ended with a full term child which died shortly after birth as a result of difficult forceps delivery.

Labor that started at 3 a. m. and a female child was born, left occiput anterior, without difficulty at 12:45 p. m., a dose of pituitrin being given at 12:30 o'clock had been applied to the second fetus after a reasonable wait, and the head and shoulders finally delivered. No further progress had been made when the case was seen at 5:30 p. m. The fundus of the uterus was half way between the umbilicus and the ensiform cartilage. It was about the size of an eight months gestation, rather globular, and contained fluid under tension. The head was low and the shoulders filled the vaginal outlet. The cervix was tightly contracted around the thorax. It was decided that a large meningescele was present. To give more room the head and arms were removed. A trocar was inserted into the flaccid

mass and about 1000 ccm. of clear straw-colored fluid drawn off, after which the under parts were readily delivered. A single placenta was delivered.

Genetic specimen. It was of a white infant. The head, shoulders, arms, and left leg had been torn off. There was an opening in the abdominal cavity in the lower right quadrant. The external genitalia consisted of a thick whitish one-half inch long anal labia map resembling a cleft scrotum. At the usual position of the anus there was a relaxed rounded opening showing a hymen like membrane forming its anterior wall and extending in scimitar shape over the anterior part of the opening. The whole surface of the body appeared indurated. The thorax was short and broad, apparently flattened by longitudinal pressure. The pelvis was in a similar condition. The abdominal wall was thick, especially in the lower half, being here of about one inch in thickness, and composed of macerated indurated connective tissue. The cavity was empty but showed indications of having contained about 1000 ccm. of fluid. The peritoneum was smooth and glistening. The liver was slightly small and brownish red in color. The kidneys and adrenals appeared normal and were in the usual position. The heart, lungs, spleen, and stomach showed no gross change.

The whole of the intestine except the rectum was attached to a long apron like mesentery suspended from just below the stomach. The rectum was the size of an adult thumb and was distended with a tough greenish mucous material. It was on the right side in the usual position of the cecum, the upper end passing up to the left to join the large intestine on the mesentery. The lower end passed through the peritoneum at the firm of the pelvis in the midline posteriorly where it was but to eight. The whole intestine was markedly hypertemic and all except the rectum was contracted and contained yellow mucous material.

The pelvic organs except the unlevelled ovaries were not to be seen, as the pelvic cavity and all its contents appeared to be behind the peritoneum which was of ligamentous proportions in this region. On attempting to trace the pelvic viscera the following conditions were found in this region:

Beginning at the umbilicus anteriorly, this forming the neck and stretching out downward to fill the lower abdomen and up to the level of the lower pole of the kidneys, behind the peritoneum was a sac large enough to admit the closed fist. Its walls varied in thickness from a few millimeters to one and one-half centimeters, and at the thinner portions yellowish calcareous bodies showed through. Its wall was composed of 3 layers, an outer fibrous layer, a middle smooth muscular layer, and an inner mucous layer. The mucosa was hypertemic at places smooth at others corrugated or plicated and these projections were covered with whitish flaky crusts which seemed to penetrate into the wall at points. This sac emptied through the pelvis and out of the once perineal opening. There was no other external opening. It was entered above by the rectum at the place where it disappeared through the peritoneum through an opening admitting a very small probe. It was also entered by the ureters at normal appearing orifices at the upper right and



Fig. 1. Persistent cloaca with ascites. a Hypogastric artery. u opening of ureter. r rectum. o ovary. e entrance of rectum. c cloaca with c chitons.

left corners. Small red undeveloped ovaries and parovarium lay under the peritoneum over the upper right and left surfaces of the cavity wall.

The hypogastric arteries were tortuous and thick walled, passing through the oedematous, tough, ligamentous, outer coat of the cloaca.

Summary of gross diagnoses. Pressure deformity of thorax and pelvis. Unusual mesentery to whole intestine. Acute enteritis. False hermaphroditism. Undeveloped ovaries. Persistent cloaca with chronic inflammation of wall. Ascites (Edema and fibrosis of abdominal wall. General oedema.

Microscopic findings. Heart and large vessels normal. The lungs were normal and unexpanded. The spleen was engorged with blood. The malpighian bodies were composed of only a few lymphoid cells around the arterioles. The kidneys were of the normal appearing fetal type. The adrenals contained very little medullary and chromaffin tissue, the outer cells of the cortex stained well, the inner cells poorly. There was little vacuolization of cells, the vessels were congested, there were small hemorrhages into the substance.

The liver showed slight periportal round cell infiltration with congestion of the radicles, and the cells were small and contained brown granules of pigment. There was mucoid degeneration of the epithelium of the intestine with desquamation, marked by peritoma especially of the mucosal capillaries, oedema, and slight leucocytic infiltration. As to the thymus, Hassall's corpuscles were small and not numerous. They were composed of rings of large hyaline flat cells or hyaline concentric ring layers of non-nucleated material or a rim of hyaline cells or material with a body of granular cytoplasmic and nuclear particles in a space. The walls of the hypogastric arteries were thick with an increase of fibrous tissue in all coats. The tissue surrounding these arteries was densely fibrous. The epithelium of the lower abdominal wall was thin. The subcutaneous tissue was much thickened and was of a very loose, spongy, connective-tissue type. The cloaca was lined by stratified squamous epithelium throughout. The thick parts of the wall had the following appearance. The epithelium was of varying thickness, from two to ten cells, and was covered by a layer of stratified material resembling the corneum of the skin. Over the polypoid projections the epithelium

was thin and the cells degenerated. The subepithelial coat was of loose connective tissue, thick, and encroaching on the muscularis. The smooth muscle coat was somewhat thicker than in the adult bladder wall. It was composed of irregular bundles and contained an equal amount of connective tissue. The outer coat was thick and composed of fibrous connective tissue. The vessels were congested and there were many clusters of brownish pigment throughout the wall. At the very thin parts mentioned previously, the epithelium was indistinguishable, and the whole wall was of hyaline connective tissue with scattered areas of calcification, congested vessels, and hemosiderosis.

Summary of microscopic diagnoses. Acute catarrhal enteritis, spleen—congestion, hypoplasia of lymphoid tissue and malpighian bodies, adrenal—congestion, microscopic hemorrhages, hypoplasia of medullary and chromaffin tissues, liver—chronic passive congestion, chronic portal hepatitis, thymus—hypoplasia and degeneration of Hassall's corpuscles, abdominal wall—oedema and fibrosis; hypogastric arteries—sclerosis, cloaca—chronic passive congestion, oedema, chronic fibrous inflammation, with hyalinization and calcification.

SUMMARY

Here we have a case of monochoorial twins, one a well developed female, the other, also a female, with failure of development of the pelvic viscera beyond a certain point and a marked oedema. We believe that the underlying factor in the maldevelopment and the oedema was one of poor circulation with impoverished blood by reason of the stronger sister usurping the cream of the nutrition from the common supply or even bringing about a relative stagnation of the circulation in the weaker by reason of its superior power.

The case was interesting to us on account of the abnormality present and also because of the interference with delivery by the ascites.

THE INTERNAL SPHINCTER AFTER PROSTATECTOMY¹

By G S GORDON MD, CM, FACS, VANCOUVER, B C
Urologic Surgeon, Vancouver General Hospital

A FAMOUS Danish surgeon once offered to furnish a volume of his mistakes for the edification of the International Technical Surgeons' Association. He thought his errors would teach more than his successes.

With this precedent I had intended to place on record three cases of occlusion of the internal sphincter following prostatectomy. The first occurred four years ago. The other two followed closely on each other quite recently. The condition in the last two was recognized and remedied. A further study of other cases then on hand convinced me that partial occlusion is frequent following removal of prostatic growths, and that this is insufficiently recognized or it would be better guarded against at operation. I have, therefore, added two cases of partial occlusion.

Adenomata in the prostate are commonly found on the sides and floor of the prostatic urethra. In the process of growth they usually amalgamate more or less, press on the internal sphincter, protrude through, and progressively dilate it. Not uncommonly a mass consisting mainly of the median lobe, so called, is thus grasped by the sphincter about its waist, its upper part free in the bladder in front of the trigone while its lower part is surrounded by prostatic tissue which is much attenuated by pressure of the growth.

From an operative standpoint, the intravesical lobe, if present, is of little interest. The embedded portions, however, claim our attention. Of these the intrasphincteric, besides holding the sphincter dilated, leaves a raw edge on enucleation which is important to remember and will be referred to later. The intraprostatic portion pushes itself under the trigone and the lateral walls of the bladder and on enucleation leaves an unsupported, somewhat crescent shaped, flap of bladder-wall with the dilated sphincter on its free edge. This flap is usually deepest behind and defaults entirely in front except in those rare cases involving an anterior "lobe." Following enucleation of the adenoma its bed contracts at once but not enough to close the opening between the bladder and anterior urethra. Collargol skiagrams have been published showing this opening to be funnel shaped with its mouth at the bladder neck and outlet at the external sphincter. These pictures show only the sides of the bladder

merging with the sides of the new formed urethra. I am sure they do not show the universal condition of the sides and they do not show at all what has happened at the posterior commissure. If at operation the internal sphincter of the bladder has entirely and permanently lost its function, such pictures will be obtained after healing. The loose flaccid bladder flap has applied its denuded side to the denuded bed of the adenoma and adhered to it, and the bladder cavity and newly formed posterior urethra are practically one. This does not always happen—perhaps it happens only infrequently. In a large proportion of cases the sphincter contracts more than the rest of the denuded cavity and does so immediately, and this contraction progresses with time as the circular fibers gain greater tonicity. In rare instances this contraction is so forcible that the raw edges of the sphincter are purse strung together, heal in apposition, and totally obliterate the outlet. In such cases a retention catheter or the passage of a sound would prevent complete closure, but then the sphincter opening will be at most only the size of the meatal opening because such instruments must pass through the meatus. The sphincter admits the tip of the finger and while a catheter may prevent its occlusion it does not guarantee that the sphincter at urination later will dilate to finger-tip size. As a matter of fact this opening is often sclerosed by fibrous tissue in the process of healing and cannot dilate. In the common run of cases the bladder outlet is patent enough but even in these the contraction of the sphincter muscle on its edge raises the trigone part of the flap above the base of the bladder and causes more or less obstruction to urination. In ratio to the degree of this obstruction, the force required to empty the bladder is increased, back pressure persists preventing improvement in trabeculation or diverticulation, preventing retraction of overdilated ureters and renal pelves and the kidney itself at urination is thus periodically compressed from within. This valve has a pocket immediately behind it and tends to perpetuate a bag fond behind the trigone. Gravel tends to accumulate here and agglutinate into stone. All these sequelæ to obstruction favor continuance of cystitis and all are in ratio to the degree of obstruction. This valve action is not

¹Read before the North Pacific Surgical Association, December 18, 1915.

theoretical merely, as I hope to demonstrate by the following cases. The actual closing of the bladder outlet by the sphincter muscle is also illustrated below, as well as the formation of stone from gravel in a retrovalvular pouch. I believe that although our results of prostatectomy are among the most satisfactory in surgery, they can be bettered in nearly all cases, by attention to this sphincter flap at the time of operation. Chronic cystitis and pyelitis, to a continuance of which we have heretofore resigned ourselves, will show more improvement, urination will be less frequent and freer and life will be pleasanter and longer for these old men if this obstruction is removed.

CASE V (14 12 32) Partial obstruction following prostatectomy

An excessively fat steam engineer 60 years old was referred by Dr. Maxwell for hematuria, lasting off and on for 22 months frequency of urination, and dysuria. The urine was stringy, alkaline and bloody and contained triple phosphates. The stream was interrupted at times, slow and painful, but otherwise normal. On January 11, 1915, I removed a phosphate stone from the bladder and four days later a left lateral and middle lobe from the prostate. A bulging on the right side of the urethra was considered inflammatory and was left alone. Three days later the suprapubic tube was removed and on the ninth day a No. 27 sound was passed easily. The following weeks were stormy; a generalized eczema did not add to his comfort. Janet irrigation did not save him from epididymitis. His suprapubic wound opened and closed from time to time nor would it heal permanently when later on a catheter was left in for ten days. In time he left the hospital. His bladder was washed out frequently with silver nitrate 1:1000 urotropine was pushed, and once the internal sphincter was dilated to a No. 35 French. Finally on July 28 I reopened the bladder and found the internal sphincter raised above the trigone, of very small caliber and infiltrated by dense scar tissue. The bulging on the right side of the urethra had disappeared. Forceful generous dilatation of the internal sphincter, removal of the scar tissue about the abdominal fistula, and drawing together of the abdominal wound has given a result satisfactory to him. There is still a distinct check to the catheter on entering the bladder and his urine continues foul but his general health is good.

CASE P (15 9 7) Partial obstruction after using Hagner's bag — Young's punch

In September last a feeble man of 65 was referred to me by Dr. Weld. He gave the usual history of nocturnal urination for years and then intermittent catheter life. On entrance to the hospital he was delirious at times and his mental processes were slow, rambling, and inaccurate. The temperature was 102° pulse 115, urine foul and malodorous. The bladder was greatly dilated there was an inguinal rupture and protruding hemorrhoids, the prostate was even enlarged, emphysema obscured the area of cardiac dullness, the heart sounds were clear but weak, regular and with no murmurs, the second sound slightly increased systolic blood pressure 128, diastolic 90, and the kidneys were negative to palpation. With the gradual drawing-off of the urine his condition improved but it was not till 18 days after that Geraghty's test indicated cystotomy under gas and oxygen and three weeks more before prostatectomy could be done. Three lobes were removed

and Hagner's bag used to control hemorrhage. This was followed by a retention catheter. One month later, as his urine was still very cloudy and he had dysuria one day with a temperature of 100°, he was cystoscoped. The sphincter flap was elevated well above the floor of the bladder and had a poly-p-like nuch on it. The sphincter was trimmed with a Young's punch and his urination has been free since.

CASE M (14 11 1) Partial occlusion of the bladder following prostatectomy resulting in retention of gravel and the formation of secondary stone

A feeble, puny man of 70, a jeweler, lame from a paralytic stroke 20 years ago, was referred to me by Dr. MacNaughton of Cumberland in November, 1914, for frequent, painful, and urgent urination, intermittent stream of poor projection and caliber, bleeding following catheterization, and urine foul with pus and phosphates. His prostate was enlarged per rectum and tender, but without adhesions to the surrounding tissues. Cystoscopically there were two lateral and one median lobes. There was no stone. On November 7, suprapubic prostatectomy was done. On November 24, he said he passed gravel per urethram. On the 26th, his wound was permanently closed and he was discharged on December 5, "well" and "with free stream." Cystitis remained as evidenced by the urine contents but he had passed no gravel for two weeks. One month later dysuria returned and he passed gravel. Later came ball valve urination when standing but free urination on lying on his left side. For four months the condition got worse and then he returned and had three (assorted) stones in the bladder crushed with complete relief. I have not heard from him since but assume gravel would not have stayed in his bladder to form stone unless it were pouched behind the sphincter. Unfortunately my notes do not state whether diverticula were present.

CASE S (15 9 32) Occlusion of the vesical outlet following prostatectomy

A farmer 55 years old, referred by Dr. T. V. Hunter, had passed no urine without a catheter for 15 months. He had pain over the bladder, up the rectum, and in the glans penis. Cottus had been impossible because of the pain it caused. He had had no venereal disease, had never passed gravel or stone although at one time he had had pain over the right kidney extending down the front of the right leg. There was no tubercular history and no known chance of contracting tuberculosis. Systolic blood pressure 144, diastolic 90. The heart was slightly increased in size and the pulse was intermittent. The urine was acid of a specific gravity of 1015 and contained some pus and blood. The prostate was almost of normal size to palpation. On cystoscopy the bladder capacity was four ounces, the bladder was trabeculated and slightly diverticulated. There were seen a median lobe and a large phosphate stone. On September 25, 1915, the usual prostatectomy was done. On October 4, a sound passed easily. On the 16th, the suprapubic fistula had become small enough to keep a large amount of urine in the bladder before bursting. He persisted in the statement that urine was coming per urethram and it was not till the 23d that this was found to be erroneous. The wound was then slit open and the internal sphincter found smoothly healed over. It was opened and stretched to admit the finger easily and a retention catheter left in for ten days. Seven days later retention again occurred and the suprapubic wound was reopened. Young's punch was used to remove a median ridge, and a retention catheter again inserted. On its removal on November 20 the stream was prompt and large and has remained so since. The fistula closed and infection and diverticulation has improved.

CASE R (15 S 26). Occlusion of internal sphincter following prostatectomy.

The patient, referred by Dr. A. W. Hunter, is a man, 55 years old, and a watchman on the Canadian Pacific Railway. He is a widower. Two years ago he had been relieved of retention of urine by medication. Cystitis was diagnosed then although he had never had symptoms of gonorrhea, lues, or tuberculosis. Since then he has had nocturnal and diurnal incontinence at times. This was of a peculiar type in that it occurred only when lying down or sitting, not when standing or walking. It was associated with no pain or scalding. Six months ago a suprapubic cystotomy was done for recurring retention with cystitis and septic absorption. His condition improved with lavage, but the cystotomy wound did not heal. Dr. Hunter, the last of a number of physicians who had seen him, referred him to me three months ago. The prostate was normal to rectal palpation and showed no bulging into the bladder on cystoscopy. The bladder, however, was trabeculated, ureteral orifices gaped and the vesical sphincter was elevated, the fistula was diverted out and an adenoma the size of the end of one's thumb was removed from the prostatic urethra. In closing the bladder the wound was extended toward the apex for drainage and the original drainage wound which lay behind the symphysis was sealed up. A tube at the apex was left in 14 days to secure firm healing below it, nine days after operation a catheter would not pass although some urine came by urethra. Twenty three days later the suprapubic wound was slit open on a director and the sphincteric opening was found completely occluded. The fibrous membrane across it was ruptured and the opening dilated. A catheter was left in the urethra and no urine subsequently reached the abdominal dressing. Three weeks later he left Vancouver free of all symptoms.

CASE D (539). Occlusion of the vesical outlet following prostatectomy.

The patient was referred by Dr. J. L. Turnbull. A growth of the size and somewhat the shape of a cricket ball was removed in one piece by Meyer's method. This typically benign adenoma was pronounced malignant by a competent pathologist. My notes do not state the day a wound was passed but 30 days after operation the suprapubic wound was healed and retention occurred which was relieved by the passage of a small size coude. At this time there was pain over the right kidney and pyuria. As dysuria persisted, a few days later a posterior Kollman dilator was passed and enlarged to a No. 37 French. There followed some relief but the stream became smaller and smaller until finally the suprapubic wound reopened and there were chills and fever. He persisted in having no further surgical interference and Dr. Turnbull tells me he died uræmic three years later. For three months

before death urine came by rectum. That a sphincter so largely dilated by this growth would contract down to obstruction point in 30 days is remarkable.

Four years ago the first case, the last here reported, presented itself and since then I had often speculated on the exact pathological condition present after this prostatectomy. The usual technique satisfied me for three years after this, and then came the deluge. I have already indicated that removing the valve on the urethral floor remedies the condition, but a review of cases in preparing this paper was necessary to bring home to me the desirability of dealing with this valve at the time that prostatectomy is done. I have demonstrated that neither sounds, indwelling catheters or maintained distention of the sphincter with Hagner's bag after the usual technique in removing the prostate are adequate. There are two courses open at operation: one to remove the crescent entirely, the other to split it completely through in the midline and on each side, making two flaps, applying the raw side of these flaps to the denuded urethra and holding them in place by a Hagner bag, which is used to control hemorrhage but which is ideal for this purpose as well. In a few days the bag can be replaced by a mushroom headed retention catheter, care being taken not to disturb the grafts. The first expedient will appeal to those who follow Albarran's teaching that a catheter should not be left in for fear of spreading infection, the latter to those, among whom I am at last a convert, who believe that back pressure of infected urine has already produced immunity in almost all of these cases and that the pressure of this foreign body in the urethra is not apt to cause deleterious absorption of toxins. The only cases I would not treat by flap-splitting are those having oncoming infection from beginning catheterization. I have adopted this technique too recently to be able to give you records of its value.



Mr. L. Rodman

WILLIAM LOUIS RODMAN

TO master the principles that underlie the profession, and then to do the day's work — that is *grand business*. And that was the singular record of the late Dr. William L. Rodman. He held his profession as a great trust, and, with a mind big enough and broad enough for genuine leadership, with industry, confidence, imagination, and humor, all organized for effectiveness, he did the day's work. Dr. Rodman, whose name now passes into the history of medicine, was both scholar and medical philosopher. He conceived his trust as a human service, and, with research guided by trained imagination, with virile and fearless criticism, and with sound observation, he was an inspiring leader of men.

Dr. Rodman was born in 1858 in Frankfort, Kentucky. He received his early education at the Kentucky Military Academy, and on graduation from the Academy, began the study of medicine with his uncle, Dr. James Rodman. In 1879 he was graduated from the Jefferson Medical College, Philadelphia. After serving as an interne for one year, he entered the army medical corps, and for two years was stationed at Fort Sill, Indian Territory. Leaving the army service, he began the practice of medicine at Abilene, Texas. From this field of activity he was called to the University of Louisville as demonstrator of surgery, and from Louisville, in 1899, he was called to the Medico-Chirurgical College of Philadelphia as professor of surgery, which position he held to the end of his life.

Honored by positions of great influence in the profession, Dr. Rodman worked tirelessly for the advancement of medical education. His effort in this direction found most significant expression in the National Board of Medical Examiners, which he not only conceived, but, through many years of effort, brought into existence.

At the time of his death, Dr. Rodman was President of the American Medical Association, having been President of the Surgical Section of that association in 1897. In 1902 he was elected President of the Association of American Medical Colleges. In 1911 he was elected President of the Philadelphia Medical Club; and was a member of the American Surgical Association, of the International Association of Surgeons, and of the American College of Surgeons.

He was an associate editor of the *International Text Book of Surgery*, and the author of significant chapters to other medical works. The result of his studies on cancer attracted world-wide attention.

After an illness of but a few days, Dr. Rodman died at his home in Philadelphia on March 8, 1916. Whitman observed that there are doctors who are only doctors, and doctors who are not only doctors. Dr. Rodman was not only a doctor, he was one of the most important, valuable, and necessary of men in American medicine.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD DECEMBER 3, 1915, WITH DR. WILLIAM R. CUBBINS, IN THE CHAIR

WAX MODELS

DR EDWARD H OCHSNER Wax has been used from time immemorial to preserve copies of the form and contour of different objects and also for the purpose of making records of events. I understand that within the past ten years a number of wax tablets have been discovered in Greece which are considered by archeologists to be the oldest records extant. One reason why wax is so useful for these purposes is because it is practically indestructible except to heat and mechanical insults. The ordinary micro organisms, the micro organisms that cause putrefaction, have practically no effect upon it.

In medicine wax models have also been used for many centuries most successfully for the purpose of recording form. Many attempts have been made to record not only the form but also the color, but most of these attempts have been more or less of a failure. The principal reason why they have been a failure in this regard is because artists have found it almost impossible to color wax without over coloring it. Most of the wax figures I have seen have reminded me of the chorus girls in the vaudeville, they have too much paint on. The only wax models I have ever seen personally that were accurate copies of the originals were some of the wax models which I saw twenty years ago in Guy's Hospital in London. I suppose there are other artists who have succeeded in coloring wax and making it look natural, but if so their work has not come to my notice. The artist who made the wax models at Guy's refused to divulge his secret and with him his secret died. I very well remember and I can visualize today, a wax model of Paget's disease of the breast by this artist. It is the most perfect object of medical art I have ever seen.

Last spring I became acquainted with a young Milwaukee artist who was at that time and is still making models of mushrooms and toadstools and puffballs for the Milwaukee Museum of Natural History. After speaking with this young woman and especially after seeing her remarkable work in the Milwaukee Museum, it occurred to me that there was an opportunity of reviving a practically lost art. I suggested that she attempt to make wax models of pathologic specimens and to color them. Not being in active practice at the time I had no clinical material at my disposal but it occurred to

me that my friend, Dr Hodgson, of Waukesha, Wisconsin, might have suitable clinical material. It also occurred to me that a case of terminal gangrene either senile or diabetic would be particularly suitable for a trial. Dr Hodgson has had marked success with diabetes and has achieved a national reputation in the treatment of the affection, and I thought that he might possibly have a case of diabetic gangrene on hand. I communicated with him, and within a week or ten days he called me up and said a case would be at our disposal at any time. Miss Allen, the artist, and I went to Waukesha. She made a plaster mold of the stump of the foot poured the mold and after this had set and hardened she colored it, and those who have seen the original and also the model agree that it is practically impossible to tell the two apart. The patient was an old woman, eighty four years of age, who some three years previously suffered from senile gangrene of the foot, of type No. 1, as described by me in a paper on senile gangrene some years ago. She had spontaneous amputation of the toes, which left an ulcer. I understand no particular effort had been made by her family physician to heal this ulcer, because she was eighty four years of age and it did not seem worth while. The patient had been under Dr Hodgson's care only a short time when I saw her.

The model which I pass around shows that the skin had been subject to the influence of secretions hence is considerably reddened and there are flakes of yellow lymph here and there and a number of projections of epidermis. The model is an accurate copy both in form and color of the original.

Miss Allen, who is here, has brought with her this evening a cast of her sister's hand and a life mask of her sister. The sister has been good enough to come from Milwaukee, in order that the model may be compared with the original, so that you can judge for yourself as to the excellence of the work.

Miss Allen has also brought along a group of mushrooms which I think you will agree with me look good enough to eat.

It is rather humiliating for a Chicagoan to have to go to Milwaukee in order to see certain museum specimens but I cannot pass this subject without saying that Milwaukee has a remarkable man at the head of its museum who has gathered around him self a group of remarkable artists, and that in

this relatively small city there is one of the finest museums of natural history in this country, one that rivals in many respects and surpasses in some of its departments the Smithsonian Institute in Washington.

So far as I have been able to determine wax models have only a few minor disadvantages. They are rather delicate and must be handled with care. They must not be dropped or scratched. Since they have to be made by an expert they are somewhat expensive but I believe for the more rare pathological lesions and for permanent records they will be of very great value.

ENDARTERITIS OBLITERANS WITH SYMPTOMS OF INTERMITTENT CLAUDICATION

Dr. L. L. McARTHUR. You all know the suffering, the tediousness and the apparent hopelessness for any surgical relief of gangrenous toes incident to that peculiar vascular disease which, in the past, went under the term of intermittent claudication but has more recently been accepted as a thrombo-angitis of Buerger. Because there seems to be some hope as a result of Koga's experiments in the use of the Locke or Ringer solutions I present a group of six cases. They have come into my service in the past six or eight months. They have all been sufferers either by a toe or a finger or the whole foot becoming at times black, at times blue always painful ultimately gangrenous usually associated with a loss of pulse in the vessels of the foot, sometimes in the hand.

We now have to group gangrene cases into (1) syphilitic arteritis obliterans, (2) the thrombo-angitis of Buerger, (3) diabetic gangrene and (4) arterio-sclerosis (senile). The second subdivision is perhaps most emphasized by the intense neuralgia by the cramps that come on in the early stage of the disease in the muscles of the calf of the leg. Usually after a very brief walk of two or three or four blocks cramps occur.

Here is a case the inner side of whose foot was black and gangrenous. A portion has sloughed off, then healed over so well that you would not suspect such trouble to have existed. Healing has taken place by a 1000 ccm. of Ringer's solution administered hypodermatically twice a week.

Here is a man who failed of relief by this treatment having had twenty eight injections in New York for a gangrene of his foot which later they amputated. Both feet are now gone. He came to me to amputate the ring finger of the left hand. After having had twenty eight injections elsewhere he refused to try it further. The finger was amputated. I present it as an interesting example of this disease affecting both the hands and feet.

The next patient I saw in February of this year. After having a period of seven months with a painful and ultimately gangrenous toes the first toe went black and the toe of both feet became black and gangrenous at the tips. He had gone to a

seeing him been operated on for a gastric ulcer. This man was a pitiable object. He would cry when you went into the room. The slightest motion would cause pain. He lost all self-control. After the salt solution of Koga the gangrenous portion separated. The pain ceased. Where there was a dead terminal phalanx, it was lifted out. The areas have healed over with normal cicatricial material under this line of treatment.

We have had, as is rather natural, a number of such cases appear in the service at the Michael Reese Hospital since it is a disease peculiar to the Jewish people. The cases which I have had an opportunity to treat have been relieved of the pain, relieved of the need of taking morphia or anodynes of various types. Some have refused treatment because they had similar treatment elsewhere. The wounds healed slowly, taking six, eight, or ten weeks.

I want to show a case of gastro-enterostomy because of its interest clinically. One of our Fellows operated on this man some two years ago for a case that was clinically typical of a gastric ulcer. On opening the abdomen no evidence of ulcer whatever was found, there was a spastic pylorus for which a pyloroplasty was made. The symptoms continued for a year and a half or so he has been trying various medications finally drifting into the Michael Reese Hospital where my colleague, Dr. Friedman, studied carefully his case with the X-ray. He discovered a persistent notch defect far over on the left side of the cardia that showed up regularly in the skiagrams. Various other pictures showed it more markedly than the one I exhibit. The patient sought operative interference again. At operation the stomach appeared and felt absolutely normal to all intents and purposes, its emptying time was about normal. There was some hyperchlorhydria and there was distress after eating. With the abdomen opened I told Dr. Friedman that while there was no ulcer of the stomach there was a tumor of the tail of the pancreas well to the left. I made a temporary opening into the gastroduodenal omentum examined the posterior stomach wall where an ulcer of crater type was located at the cardiac end which had made adhesions and inflammatory infiltration of the tail of the pancreas. Dissociating it loose from the pancreas I succeeded in finding an ulcer of the stomach which had perforated at its apex excised the same, and then sutured the opening made by excising it. Remember, the stomach was everted and sutured half to be done on the posterior portion of the cardia and has resulted in the picture which now shows an almost hour glass type of stomach because in suturing it narrowed the lumen there temporarily. The picture was taken three weeks after operation. From the time the man came out of the anæsthesia he has been free from pain.

I had a call recently to the Michael Reese Hospital from a man suffering from intestinal obstruction which had existed five days. He

having been operated on twice in other cities before coming here for the trouble which he had, was nevertheless not able to tell us just exactly what had been done at the time of admission. On examining him I found he was as tympanitic as one ever sees an abdomen and had gone a week without a bowel movement. On opening his abdomen I found an enormously distended sigmoid, as large as ever seen even in Hirschsprung's disease. The obstruction proved to be an enormously distended sigmoid volvulus. This is the third time he has had a volvulus, as we found out by writing to the surgeon who had operated on him on previous occasions.

I bring him here to suggest cases of volvulus of the sigmoid of this type are not an uncommon affection in which fixation or sigmoidopexy is advocated after having made a side-to-side anastomosis. In this particular case with a tumor simulating an enormously dilated stomach, it was easy to bring the two loops together, make a generous anastomosis, and then suture the two long loops together. These were emptied by introducing a tube into the rectum after having undone the twist, and the loops were then anchored at the umbilicus. It happened in this particular case that an adhesion which had occurred at the former operation was present on the inner surface of the abdominal wall and made a good peg on which to hang the top of the sigmoid, and since this has been done I do not think he will have any more torsion of his sigmoid.

DISCUSSION

DR A J OCHSNER Since Dr Strauss reported at a former meeting of this society the treatment for this condition by means of Ringer's solution, we have had three cases, two with the condition described by Dr McArthur, and one case of diabetic gangrene, with tremendous pain. In the latter case, the pain would stop only for a short time following the use of morphine, while it stopped for twenty-four hours after the use of Ringer's solution. The patient is a man for whom I amputated one leg five or six years ago for gangrene, and who returned with gangrene of the great toe, with excruciating pain, which we tried to control without success with morphine for a time. However, after I used Ringer's solution, the pain stopped immediately and he would remain free from it for twenty-four hours. He has been under treatment now for ten days, and four days ago we stopped the solution, after which the pain returned, but subsided again after giving 1000 ccm of Ringer's solution hypodermically.

DR DANIEL N EISENDRATH I have been much interested in this subject of thrombo angitis because we have had so many cases at the Michael Reese Hospital, and we are inclined to resort to conservative rather than radical measures such as we have undertaken in the past. The majority of these cases come to us with gangrene of one toe, and with such excruciating pain that even morphine will

scarcely relieve them. The etiology of this pain is not understood. It is supposed to be an irritation of the nerve walls of the blood vessel itself, and a measure has been tried by Dr Libenthal of New York recently, who claims that in these cases he has obtained immediate relief of the pain, by ligation of the vein of the extremity. I saw him do this recently in New York. I saw a case which Dr Carl B Davis of this city had of this kind at the Presbyterian Hospital in which I suggested that the same measure be tried after numerous attempts were made with Ringer's solution, namely, relieving the pain by ligation of the femoral vein.

In the majority of these cases we have been obliged to amputate high up, and the most successful amputation we have been able to do was the Gritti-Stokes. Usually the artery is found occluded as high as the point of the bifurcation of the popliteal.

Dr McArthur in showing a number of these cases recently spoke of a case not long ago where the circulation had been re-established after the use of Ringer's solution. I believe this method has a very important place, because otherwise the radical measures are the only thing we can offer the patient.

The second case Dr McArthur showed of ulcer of the posterior wall of the stomach is of considerable interest to me. I see so many cases laparotomized for suspected ulcer of the stomach, and the ulcer does not present itself on the anterior wall, the case being classed therefore as a mistake in diagnosis. I have employed an exploratory gastrostomy for the past two years. Whenever I am not sure of the presence of ulcer of the anterior or posterior wall of the stomach, and yet the symptoms are so typical of it, that I feel confident of it, and I see a slight induration on the wall of either the stomach or duodenum, I have done an exploratory gastrostomy. I make an incision two or three inches in length on the anterior wall of the stomach, about two or three inches proximal to the pylorus, and insert my finger into the stomach and explore it or evert the mucosa. It is a simple method and I can recommend it to you. You can actually palpate the ulcer if it is of any size. If you do not find the ulcer you can easily close up the opening. It is certainly something I can recommend.

DR L L McARTHUR In regard to Dr Ochsner's question concerning the nature of the solution, I would like to say that Ringer's solution is a standard one, the formula of which can be found in all physiologies. It is an official solution. Some have used the Japanese or Locke solution, which is also a physiological solution, which is as near an imitation of the blood salt as is possible to make in the laboratory. A very remarkable thing was noted in some of these cases and that was the absolute return of pulsation in the dorsalis pedis or tibialis posterior. In one case there was a return of the pulse at the wrist which everybody noticed as absent when the patient was admitted to the hospital. The nurse called attention to the fact that

the patient was pulseless, thinking it was very serious when taking the pulse and temperature for the record, but could not find it. After treatment the pulse returned definitely.

Dr. Strauss made a section of one of the arteries in a limb amputated a year or so ago for this affection by me at the Michael Reese Hospital. He found a normal posterior popliteal artery where it entered into the calf of the leg it had what appeared to be a new-growth in its lumen. This was an organized clot for a certain distance, perhaps three inches, below which a normal artery again presented. There seemed to be a plaque deposit on the interior of the vessel.

Buerger has shown sections of such deposits or organized thrombi through which small capillary vessels have gone or tunneled to make a passage-way for the blood, there is an actual return of circulation in vessels that otherwise would have been not palpable.

In regard to this case of ulcer of the stomach, I think a compliment should be paid to Dr. Friedman in his careful study with the fluoroscope, taking a picture not in the ordinary conventional way, from before backward, but in an oblique position. It was in this way this ulcer was discovered.

VARIED TOPICS CONCERNING THE SURGERY IN INFANTS AND YOUNG CHILDREN

DR. COLEMAN G. BUFORD read a paper entitled "Varied Topics Concerning the Surgery in Infants and Young Children" (See p. 546).

DISCUSSION

DR. CHARLES A. PARKER. I have enjoyed Dr. Buford's exposition of this subject very much, and as I have worked with him I know just how true all of it is. I shall not attempt to add any original matter to what he has given you, but shall simply go over some general points as I have observed them, because I work in the same hospital with him, or did formerly, and all of you know what an interesting subject the surgery of childhood is. It is the most optimistic surgery we have.

We have the general processes of surgery as they affect children, and we know how quickly they react to serious operations accompanied by the loss of blood and loss of heat. And we have the many surgical conditions to which children are particularly liable, or the essential surgery of childhood and they may be grouped under congenital conditions and those that arise more frequently in childhood. The congenital conditions occur from the head down, the hare-lip, the cleft palate, the hydrocephalus, and the various neuroceles down to the hirth hernia, or hernias that may bring on the later spastic conditions that need attention. Dr. Buford spoke of obstruction of the intestinal tract, particularly at the pylorus and going farther down we come to the surgery of the urogenital region with the various

kinds of penile and vaginal fistulae, besides rectal closures, of which we have read so much in the newspapers very recently. Passing from those conditions we come to the deformities of the limbs which in many instances can be corrected by orthopedic surgery, such as birth deformities, club-foot, numerical and other variations of the digits, congenital dislocation of the hip and other rarer congenital deformities.

Again, in children, we get the tubercular infections in which the joints, the spine, the hips, knees and other regions are involved. Furthermore, we get the deformities due to rickets. We get those in children at the time they should be corrected. It is one of the best chances to use our favorite remedy in tuberculosis and in many other conditions, and no matter what our remedy is, if it does not do harm to the child, we can get favorable results. That makes us optimistic again. The child will grow up if you feed him. He will gain in weight and attain greater height as he advances in years.

DR. JOHN F. GOLDEN. I presented a case today before the senior clinic of the Northwestern University Medical School which showed the result of an operation which I performed two months ago before the same clinic.

The child was referred to me by a pediatrician with the following history. The child at the time of birth weighed nine and a half pounds. At the time the child was presented to me it weighed five and a half pounds. In other words, the little one had lost during the two months of its life almost half of its weight — four pounds.

I did the usual posterior gastro-enterostomy and was surprised that the only place where the child lost much blood was when I made the incision through the stomach and jejunum. At this point a slight amount of blood was lost. I took the ordinary syringe filled with paraffin, sterilized and heated it, squirted out the paraffin, and drew two ounces of blood from the mother's vein and injected it subcutaneously into the child's breast. That was done two months ago and the child has gained a pound a month, and it is a perfectly healthy normal infant. Inanition at the time I operated was very pronounced. The skin was drawn over the child's bones.

In cases of extreme inanition and loss of blood I shall be interested in hearing what Dr. Buford has to say, in his closing remarks with regard to the subcutaneous injection of blood.

DR. D. W. GRAHAM. It has been my custom to recommend operation for inguinal hernia in early childhood, because so many of these cases are seen in families in which the mothers have to take care of several other children, and under the circumstances a truss can hardly ever be well managed. Moreover the most humane thing we can do for a mother so situated is to operate, and I have always followed that course.

I have not seen the danger attending the administration of an anesthetic to children that Dr. Buford

speaks of. While there may be a little more risk than in the adult, this can be eliminated with extra care on the part of the anesthetist. Of course, the operation itself is more difficult than it is in an adult from the standpoint of the surgeon.

In regard to the infection of wounds that are healed by urine, the urine of children is quite harmless and wounds situated over the region in which soiling is likely to take place may be left without any dressing whatever if the diapers are changed whenever they are soiled. One may leave off all dressing, seal the wound with colodion, and these little patients are very much better cared for than if you put on a gauze dressing and expect it to protect the wound. Instead of a protective it will hold the urine, serve as a urinary catheter and be detrimental. I prefer this method rather than that which Dr. Buford has described in his paper.

DR. DAVID N. LINDENBATH: This subject of the surgery of children is one that is very important because, as Dr. Buford says, there are many deviations in children. In the same condition in adults one of which he has referred to, and that is the question of rectocolitis. There are few children operated upon at the Michael Reese Hospital without having the urine examined for diacetic acid and acetone, and many a time we have avoided being led into trouble from having overlooked this in time. Personally, I like to have the urine examined for two or three days afterward for the same condition. Many cases of vomiting of bile, of temperature going as high as 100° or 102° in the first forty-eight or seventy-two hours have been easily explained by acetosis where there was no trace of infection whatever.

We give these children post-operatively every four hours four ounces of tap water containing a per cent carbonate of soda and a per cent glucose. It acts better than anything else.

Dr. Buford mentioned the dressing in hernia cases. I do not think there is any more satisfactory dressing than the one he described but I believe that one of the best dressings for a hernia in a child is that which is used in the Hospital for the Ruptured and Crippled in New York. In every case of inguinal hernia, both female and male, the application of a plaster cast extending to the knees is a satisfactory form of dressing.

As to the question of intussusception, we try to do too much for these cases of intussusception. I have seen several of them recover after first doing an enterostomy, and four weeks afterward doing a radical operation. One case that baffled me a year ago was a small baby, three months old, brought from Michigan in the third day of intussusception. Any enterostomy would have been out of question. I resected six inches of the intestine with successful outcome.

Dr. Buford has made another good point, namely, that we must be extremely careful about operating on children. We should operate on them as rapidly and with as little loss of blood as possible.

DR. PAUL F. MORRIS: When Dr. Buford spoke of the use of anesthetics, he failed to mention local anesthesia. I believe local anesthesia with novocaine and adrenalin is a distinct advantage in some cases in infants and children.

I will mention a case of imperforate anus which I operated on some time ago in which I injected about a dram and a half of less than one half per cent novocaine solution with a frenalin. The operation was done almost bloodlessly and painlessly. The testes could be felt down easily and the imperforate rectum was brought down to the anus without difficulty.

In another case of spina bifida operated on with combined local and general anesthesia only a small amount of general anesthesia was necessary. The rejection of novocaine and adrenalin solution allowed the operation to be performed with but slight hemorrhage. The child made a rapid recovery from the operation.

DR. WILLIAM R. CANNON: With regard to recent intussusception, I believe that as we make better diagnoses of intussusception and get the cases earlier and more cases recover there are going to be more recurrences than there have been formerly. It is in that reason I suggested paralleling the terminal portion of the ileum to the ascending colon and suturing it there with three or four sutures or a continuous suture. It only takes a few moments and if it should adhere—and I see no reason why it should not—it would be impossible to resuscitate the two parallel bowels. I published an article on this subject in *STURGEON, Gynecologist and Obstetrician*. I believe there will be more use for this particular line of work in the future.

DR. LOUIS G. HARRINGTON: In reference to the remarks of Dr. Graham will say that we are in the midst of research work and we are likely to try anything that seems reasonable which might be a benefit to the children among whom we work. Among those who have needed blood because of loss from acquired hemophilia or during operations we have not been impressed with the value of intramuscular injection of human blood or diphtheria or horse serum.

DR. BICK: Any human serum?

DR. HARRINGTON: No human serum but we have used the blood of parents.

In answer to Dr. Graham concerning the time to operate on inguinal hernias in infants and very young children I feel just this way about it. In special hospitals of any kind where services are provided over by men of diligence, common sense and integrity, it is a good idea to follow the methods. In such institutions attention is centralized upon their special field. Methods advocated are usually the results of the compiled experiences of a large staff. In ten or twelve years' experience with the hernias in infants and childhood on a very large scale I do not think that any angle of the hernia problem has escaped our attention.

In reference to the contention that the truss is a

care to the mother of a child and a discomfort to the child will say that this is a mistaken idea. A proper truss which fits properly is worn without one being conscious of it. Mothers who do not speak our language are readily taught how to apply trusses. We bring them back once a week to show them their faults in managing a truss and in a little while they become very adept at it. The mothers of the poor children are the easiest to teach all of the technicalities connected with the use of a truss and it is a rare thing for us to see one who seems in the least careless because of it. Difficulties arise because of improper selection of trusses and insufficient supervision of them during the first weeks of their adoption. This work should be done by the surgeon and not by truss fitters or salesmen in an instrument store. I think it is a dangerous thing to advocate routine operation for inguinal hernia in early life and it ought not to be encouraged by the surgical teachers of our country.

Dr. Cubbins has given us something new in his operation for intussusception, the suturing of the reduced gut to the colon. I have implicated such a reduced gut and sutured it with thirty-day chromic catgut to the abdominal wall and have had the intussusception recur in forty-eight hours and have had to resect the gut.

With reference to the goiter question as it concerns childhood will say that I usually see in the neighborhood of ten goiters every Tuesday afternoon, the number sometimes rises as high as twenty-two. Sometime ago I described a syndrome characterizing simple goiter and I now believe that this syndrome is the result of toxæmia. It is noteworthy that a hundred per cent of the children I have examined having goiters also have either had their tonsils removed or they are in such diseased states that they should be removed. A large majority contain pus or cheesy material which is not discovered until the tonsil is everted and its base pressed upon. I have also discussed the usual seat in which goiters in children begin, the lower pole of the right lobe, which I also think bears direct relation to the reception of toxic materials deposited into the lymph channels in this area from the lymph channels of the thymus glands. We have had the best immediate results in cases who have developed goiter in the neighborhood of the pubescent period and whose goiters are large and boggy showing no advance pathologic changes, such as nodules due to colloid accumulations or single or multiple adenomata. Nearly all of the cases of this group which have been operated upon have shown a very marked diminution in the size of their goiters within ten days. I would like to say just a word about fractures in infants and small children. We become too much alarmed at angulations occurring in fractures in early infancy and we are plating little children entirely too frequently. Let us take for example birth fractures of the humerus showing overlapping and considerable angulation. Splints do not always correct the difficulty. That seen on the X-ray plates may strike us with horror because

of the excessive deformity. Extension and position will do much but time will help us out more than is commonly supposed. In a year there may be no external deformity and the X-ray plates may show bone without angulation of good contour, the medullary canal will frequently be shown to be re-established.

Vertical extensions in fractures of the femur in the earliest months of child life are used over time. Let us take more pictures of these fractures and study the value of different positions rather than resort to this common practice of making vertical extension in the fracture of all little babies.

A REPORT OF A SERIES OF UNUSUAL FÆCAL AND GENITO-URINARY FISTULÆ TREATED WITH BISMUTH PASTE

DR. EMIL BECK read a paper entitled, "A Report of a Series of Unusual Fæcal and Genito-Urinary Fistulæ Treated with Bismuth Paste" (See p. 507.)

DISCUSSION

DR. A. J. OCHSNER. From the time that Dr. Beck exhibited his first series of cases nine years ago, we have used the treatment in an enormous number of cases and I can confirm everything that Dr. Beck has said. Any surgeon who uses the bismuth paste carelessly and does not fill the sinuses slowly, will be disappointed, whereas the surgeon who follows carefully and implicitly the directions laid down by Dr. Beck and fills the sinuses slowly with the paste, giving the bismuth time to get into all the bifurcations, and continuing the treatment properly, will get the most satisfactory results.

I believe we should use this treatment more frequently in cases of tuberculous kidney. We have used it in a number of these tuberculous kidneys with old sinuses in which in former years we would certainly have removed the kidney. We have had a number of these patients in whom a tubercular kidney had been drained elsewhere, that have been well now for years from the use of bismuth paste. It has seemed to me that possibly we would have to change the rule that we have maintained, namely, that in cases in which we have tuberculosis of one kidney, or a tuberculous abscess, we should remove that kidney at once. Possibly with the observation of a larger number of cases we may come to the point of draining such kidneys and using the bismuth paste regularly.

DR. PHENIXTER. I would like to ask as to the results obtained in cases of old empyema.

DR. E. W. ANDREWS. I will answer Dr. Phenixter's question. An old empyematous cavity that is producing constant toxæmia and has refused to heal for years has been cured by one injection clinically not after a lapse of a certain number of days or weeks, but in a few minutes. We have had a number of such cases. This is a paradox of course, because the sinus is not cured but only masked. A

young lad, who had for about three years a chronic running chest, with daily fever, some emaciation, once in a while chills, and a rather copious fetid discharge in spite of going around to the various clinics and having had irrigations, had the sinus injected with bismuth paste by one of my assistants. It was done without much result because the directions were not carefully followed as laid down by Dr Beck and mentioned by Dr. Ochsner. The paste was injected with a small syringe, but not deep enough. Next time I took a catheter and passed it to the remotest corner or lowermost pocket of the sinus and injected into it eight ounces of paste. From that moment the boy was apparently well. His fever stopped that day, and he never had a drop of discharge. In two or three days he appeared to have no longer a sinus, but there was a minute invisible sinus which would only admit a pin pointed probe, and from it minute crumbles of the bismuth paste were of course escaping. Under X-ray examination it took several months for the last of that paste to disappear, but it came out in almost microscopic particles. The boy and his friends thought he was cured instantaneously, for the reason that he never had a particle of visible discharge and never had a soiling of dressings.

The case I have related is not atypical. I have seen the same thing in several cases of bad empyems—cases we used to do Laflaender and Scheele operations on.

Dr Beck does not claim the treatment is particularly adapted to anorectal fistulae, nevertheless, I know of a number of cases which have been and can be cured by a single injection, and more especially those cases in which there are multiple sinuses. Some of them remain cured some recur. Some are cured for a year, and some are cured permanently, but I never saw one that was not markedly benefited.

Dr WILLIAM ILLER: Until I heard the case related by the previous speaker I thought I had had the most unique cure, or the most prompt cure from the use of the bismuth paste.

Several years ago a woman consulted me regarding several fistulous openings she had near the anal orifice, for which seven different operations had been unsuccessfully performed. Not desiring to add another failure in an effort to relieve her, I injected these fistulae with bismuth paste for the purpose of getting a skiagraph, to get if possible, some idea as to their location, direction, and depth.

The skiagraph showed these fistulae to run on both sides of the rectum and as high up as the pelvic brim and around close to the lumbar vertebrae. While trying to determine some kind of rational

treatment for this patient she returned in a few days and stated that the openings had not discharged since the injection of the paste. Another examination disclosed the correctness of her statement. She returned for a third examination a few weeks later, and also a year later, and the fistulous openings had all closed, and in their places were only faint scars. She appeared perfectly well.

Dr FRANK C. DAVIS: I have had several cases of anorectal fistula in which I have injected the bismuth paste, and with some exceptions the treatment has been a failure. Some of these sinuses have closed, but the great majority of them have opened secondarily. I think one of the important reasons for failure of bismuth paste in anorectal fistula probably is the size of the internal opening in the rectum, because some of the cases that have recovered and have not had a recurrence, had small sinuses and small or non-demonstrable internal openings. In those fistulae that had a demonstrable opening at the mucocutaneous line the bismuth paste had no curative effect.

Dr LUI G. HUCK (closing): In answer to Dr. Fuendrath regarding the woman with tubercular kidney, I will say that we do not have to remove every tubercular kidney. We remove it when it is acutely inflamed or involved in tuberculosis just as we would resect a joint that is acutely inflamed with tuberculosis in its beginning stages. I have treated hundreds of cases where abscesses have formed in joints, and they have healed. We do not have to resect a kidney after it has evacuated all tubercular material and there is nothing but the scars and connective tissue.

The important point I have tried to impress by the exhibition of these cases is that such patients can be cured by the bismuth paste, without resorting to hazardous operations.

Dr McVITT: Do you get any more cases of bismuth poisoning?

Dr HUCK: We have treated 1,500 cases and have not had a fatal case. The first case of bismuth absorption reported in the literature was one of my own but I think my published articles have taught physicians how to prevent bismuth poisoning. In the last three years there has not been a case of bismuth poisoning reported, although the paste is being used more extensively now than ever. It is being used in twenty of the military hospitals in France, introduced there by Carrel, who writes that there are thousands of cases in which it will be employed—since practically all gunshot and shrapnel wounds become infected, and chronic suppuration results.

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD NOVEMBER 5, 1915, WITH THE PRESIDENT, DR. S. C. PLUMMER,
IN THE CHAIR

STUDIES CONCERNING THE SURGICAL ANATOMY OF THE PARATHYROIDS

DR. EUGENE H. POOL, New York City, read a paper entitled "Studies Concerning the Surgical Anatomy of the Parathyroids."

THE EFFECT OF FOREIGN SUBSTANCES IN THE PERITONEUM

DR. WILLIAM R. CUBBINS and DR. JOSEPH A. ABR (by invitation) contributed a joint paper entitled "The Effect of Foreign Substances in the Peritoneum" (See p. 571).

DISCUSSION

DR. JOHN L. YATES, Milwaukee, Wisconsin: Some years ago a series of experiments was undertaken to determine the effect of foreign bodies upon the peritoneum. We attempted to find out the underlying factors in the causation of these adhesions and their solution, and came to the conclusion at the time that no foreign body, except blood-clots under some conditions, could be so bland as not to provoke adhesions, and these adhesions, when once formed, would not disappear from surfaces not subjected to motion in contrary direction. At that time, when I was associated with Dr. Ochsner, there were opportunities to make similar observations in the human following appendicostomies and colostomies. It was then determined that the reaction of the human and dog's peritoneum to irritation was quite identical in character and in rate of production.

Dr. Cubbins is to be commended for attacking such an important problem, and need have no reluctance in applying the results to human beings because of the threadbare argument that dogs and human beings react so differently.

I would like to ask Dr. Cubbins if the pus he used in his mixtures with antiseptics has been tested out by itself in the peritoneal cavity? It would be expected that such injections would cause peritoneal irritation, but no fatal peritonitis, because we found the most virulent micro-organisms could be injected into a dog's belly without causing the death of the animal, unless some foreign body was inserted. However, these animals were all narcotized which might readily explain variations.

DR. DAVID C. STRAUS took part in the discussion; for his remarks, see article page 602.

DR. WM. R. CUBBINS: I was glad to hear what Dr. Yates had to say concerning pus in the peritoneal cavity. The dogs into the peritoneum of which I put a mixture of pus and salt solution died within 48 hours. One died as early as 18 hours. This pus was so fatal that I did not think it was necessary to mention the fact that a fatal result had occurred.

EXPERIMENTS AND CLINICAL OBSERVATIONS ON THE ETIOLOGY AND THE DIAGNOSIS OF CHOLECYSTITIS, ESPECIALLY IN WOMEN

DR. V. L. SCHRAGER read a paper entitled "Experiments and Clinical Observations on the Etiology and the Diagnosis of Cholecystitis, Especially in Women."

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN GYNECOLOGY AND OBSTETRICS

By GEORGE GELLHORN, M.D., SAINT LOUIS

IT is an interesting coincidence that three obstetricians of foremost rank in this country have presented us with their works within the last few months and have given us an opportunity to compare their positions and experiences regarding the problems of obstetric practice.

Cragin¹ puts on record in a volume of 558 pages the methods in use and the results obtained in the Sloane Hospital for Women in New York. We gain insight into an exceptionally large material at the disposal of the author when we read of a series of 35,000 consecutive deliveries, of 223 cases of placenta praevia, 181 cases of transverse presentation, 150 cases of cesarean section, etc. This large material has been carefully tabulated, and the statistics obtained have furnished the author with a firm and sound foundation upon which he bases his deductions and conclusions. The book is divided into 29 chapters which are arranged in 6 parts comprising anatomy and embryology, physiologic pregnancy and its management, pathologic pregnancy, pathologic labor, obstetric surgery, and pathologic puerperium.

As the book is primarily intended for the use of the undergraduate student, the author has endeavored to cover the extensive field in as concise a manner as possible and to eliminate unnecessary discussion. With this in view he has made no effort to present a complete bibliography, although references to important articles on most subjects are given. The desire to guide the student and the young practitioner through the labyrinth of obstetric practice is apparent throughout the work. "The fact of a pregnant woman placing herself and her unborn child unreservedly in the care of an obstetrician carries with it greater moral obligation on the part of the latter to be loyal to her in every way than does any other engagement in medicine." The uncertainty of the summons, the long hours of waiting, the liability to criticism—these are the disagreeable features in the practice of obstetrics, which every student should carefully consider before selecting it as a lifework. But weightier than these are the satisfaction that comes with successful work, the happiness it creates, the affection it begets.

The chapter on management of normal labor contains practical hints as to every detail of preparation

of the patient and her surroundings. Antepartum douches should not be given. Vaginal examinations are essential but should be made as infrequently as possible, consistent with the knowledge needed. The correct mode of putting on rubber gloves is well depicted. When he advises short motor rides for pregnant women or suggests that a nurse should be at the home of the patient at least a week prior to the calculated date of labor, the author forgets for the moment that he is speaking to beginners whose clientele would hardly warrant such luxuries. In the question of rest in bed after confinement the author follows conservative principles. The patient leaves her bed on the tenth day, "at the end of three weeks she walks about the floor and at the end of four weeks she is allowed downstairs and out for a drive." Ward patients, on the other hand, leave the hospital, on an average, on the thirteenth day.

It seems doubtful to the reviewer whether circumcision on baby boys requires anesthesia as the author demands, or whether such an operation is often needed for the long, tight prepucial of the female baby.

The differential diagnosis of pregnancy and the chapter on ectopic gestation are excellent in their clearness and conciseness. Twins occurred 244 times in 20,000 deliveries which gives a percentage of 1.22, or about 1 in 82. An interesting contribution is added to the question whether ovulation may occur independently of menstruation. The author had to remove the ovaries from a woman who had not menstruated for seven years and found a fresh corpus luteum in one ovary, showing that the woman was ovulating in spite of her amenorrhea. As to anesthesia in the second stage of labor, the author uses ether in all cases of toxemia and chloroform in normal cases. Spinal anesthesia is justly advised against. After a year's experience with "twilight sleep" the author concludes that the advantages of the method in the majority of cases are not sufficient to counterbalance the disadvantages. Episiotomy is not recommended, and an extensive laceration of the perineum is more likely prevented by delivering the anterior shoulder first.

In a series of 25,000 deliveries, placenta praevia occurred once in every 112 cases. The sovereign method of treatment is the extra-ovular use of the Voorhees' bag, version is usually not required. Only in cases of emergency may packing with gauze and

¹OBSTETRICS: A PRACTICAL TEXTBOOK FOR STUDENTS AND PRACTITIONERS. By Edwin Bradford Cragin, A.B., A.M. (Hon.) M.D., F.A.C.S. Philadelphia and New York: Lea and Febiger, 1926.

Braxton Hicks he resorted to. Cæsarean section is reserved for exceptional cases of the complete variety with cervix undilated and hemorrhage profuse. In the treatment of pre-eclamptic toxæmia, copious colon irrigations with saline or soda solutions and the administration of chloral, nitroglycerin, and particularly veratrum viride play an important rôle. If the toxæmia does not improve markedly or an eclamptic seizure occurs, the uterus is emptied at once. Stroganoff's method is not recommended. The mortality from eclampsia is at present 11.2 per cent. Fibroids rarely obstruct labor. Only in 9 out of 89 cases was special treatment required. Osteomalacia occurred once in 20,000 cases. High forceps was applied rather more frequently than might seem desirable, namely 218 times in 2,468 forceps operations, or once in every 92 instances.

Thirty-two pages are devoted to the problems of lactation and infant feeding. The student will do well in his own interest and that of his patients, to carefully peruse this chapter and make the author's views his own. The prime importance of breast feeding is fully emphasized. The principles of artificial feeding are clearly set forth but the reader is made to understand that all reasonable efforts toward the stimulation of the mother's breast must be exhausted before artificial feeding is resorted to. Realizing the difficulty in instructing the laity, especially the ignorant women of a hospital ward service, in percentage feeding, the author has arranged an apparatus which, at a nominal cost, can be placed in the hands of women leaving the hospital and which will enable them, after having been once shown, to prepare a proper food for their baby, even should they know nothing of percentage feeding. This apparatus is called the Sloane Maternity Milk Set, and the description accompanying the set is reproduced in the text.

The concluding chapter of the book deals with infant mortality and the results obtained are given in the form of several statistical tables. An analysis of 10,000 births shows that after the deduction of stillbirths and abortions and after the further deduction of cases of congenital syphilis, weakness, and malformations, the total number of deaths was only 184 or 0.5 per cent.

In this rapid survey only scant justice could be done to the wealth of information contained in this book. We are glad that the author has permitted us to share in the treasury of his rich experience, and we welcome his work as a valuable and permanent addition to obstetric literature.

DE LEE'S contribution is an imposing volume of almost 1,100 pages. The fact that the first edition had to be reprinted several times, and that in two years a second edition has become necessary would in itself suffice as a favorable commentary. But the reviewer has so greatly enjoyed

the perusal of this book that he cannot refrain from pointing out at least some of its many admirable features. First of all, the illustrations are bound to attract the reader's attention. There are 938 of them, and they are truly excellent. It has repeatedly been insisted upon in these pages that good pictures are an essential and indispensable part of a modern textbook, particularly in the field of gynecology and obstetrics. They are primarily needed to render subject matter more intelligible to the beginner whose limited experience has not yet taught him to think, and with his mind's eyes to see in three dimensions. In addition, they directly stimulate interest and desire to learn. The picture of the interlocked twins, for instance, is bound to make the student anxious to find out how the author succeeded in dealing with so interesting and complicated a problem. Examples of illustrations that teach almost without accompanying words are those of compression of the aorta, replacement of the prolapsed cord, massage of the breast, fetal circulation, etc. It was a genuine pleasure to find the portrait of Semmelweis. The reviewer does not recall at this moment any other textbook that contains so thoughtful a tribute to the memory of the great benefactor of parturient women.

In the text itself, an extensive experience, mature judgment, familiarity with the world's literature, and above all an exceptional gift for teaching manifest themselves on every page. Wherever one happens to open the book, one is impressed with the clearness and directness of the author's expressions that can leave no doubt in the mind of the reader. A textbook for students must needs be more or less dogmatic, yet, the author possesses the rare faculty of remaining unbiased when personal experience is not sufficient to entitle him to an authoritative opinion. For example, his results with the classical cæsarean section have been highly satisfactory, yet, he concedes that the newer extraperitoneal methods deserve further trial.

The principle of Abderhalden's test and its future possibilities are set forth with remarkable precision, the various steps of the technique are omitted as only experienced laboratory workers may be trusted with the complicated and exacting details, and the reader is referred to several American writers who have taken up this method. Patients are kept in bed until the ninth or tenth day postpartum. Getting up too early seems to increase the frequency of fever in addition to other untoward sequels. In vertex presentations, the posterior shoulder is first delivered. Episiotomy is warmly recommended. "It will save the lives of many children and often preserve the sphincter ani from injury." Scopolamine-morphine anesthesia is discussed fully and impartially, but the author fears that its generalized re-employment will result in a repetition of the fetal and maternal mortalities and the morbidity of twelve years ago. Gas oxygen anesthesia has a place in obstetrics but oxygen must be liberally ad-

mixed to prevent asphyxia neonatorum. The treatment of postpartum hæmorrhage is accorded an extensive discussion, and the various methods are well depicted, including even Momiarg's belt, the limitations of which, however, are clearly pointed out. In eclampsia, prevention is more promising than treatment. Of the various forms of diet, salt-free diet has been disappointing. Increased excretion is essential, but diuretic drugs are not recommended. Sweating is dangerous and inefficient, while hypodermoclysis, on the other hand, is most valuable. In the treatment of eclampsia, the author advocates early delivery, he doubts the value of veratrum viride and is frankly opposed to renal decapsulation. The chapter on placenta prævia contains a masterly description of the entire treatment. Metreuryxis is employed intra-ovarially. Vaginal cesarean section in placenta prævia is not to be recommended, but abdominal cesarean section is a valuable method in certain cases.

It may be argued that this review does not contain any real criticism, but what of that? We might wish that the author had devoted more space to physical exercises in the puerperium, or we might look with skepticism upon local applications of a 10 per cent solution of silver nitrate as a treatment of hyperemesis, but such minor exceptions may be withheld when dealing with a work of superior merit which is well suited to bear the fame of American obstetrics to foreign countries.

Strictly speaking, Green's work does not belong in this symposium on textbooks of obstetrics. It deals with diseases of women in general, but as it includes abnormalities of pregnancy, labor, and puerperium, it may be reviewed here from this point of view. The author has chosen the form of case histories to illustrate pathologic conditions characteristic of the five periods of woman's life. The attempt at thus closely linking together the sister sciences of gynecology and obstetrics is heartily to be endorsed, and the value of this system of case teaching has been fully acknowledged in a previous review.¹

The arrangement of the book is briefly as follows. It is divided into five large sections devoted, respectively, to infancy and childhood, puberty and adolescence, maturity, climacteric, and senility. Each section is prefaced by a short introduction and a survey of the various affections to which the epoch in question is prone to be subject. The bulk of each section is made up of illustrative cases. In each of the 173 cases reported, a short history is given which is followed by the diagnosis as based upon the findings on examination. Treatment and prognosis form the ensuing paragraphs to which pathologic reports are frequently appended. Fi-

nally, there is a comment in which in epicureal fashion, the differential diagnosis is discussed and general conclusions are introduced.

It is to be understood that the book aims, not to substitute, but to supplement the more systematic textbooks. It reproduces accurately the manner in which bedside instruction is given to a group of students. Lengthy discussions are avoided, the salient points are only briefly touched upon, a certain knowledge of clinical and technical matters is taken for granted, and only here and there is a diagnostic or practical detail dwelt upon at length.

It is difficult and not always feasible to classify all gynecologic ailments according to the age of the patients. Ovarian cysts may occur in childhood as well as in later years, and malignancy may be observed prior to the climacterium. The reviewer has only recently seen an inoperable cancer of the cervix in a girl of nineteen. Classification according to the most prominent symptom would *a priori* seem preferable were it not for the fact that most gynecologic affections produce more or less the same kind of symptoms. The author has overcome the difficulty of finding the case in which the reader may be particularly interested, by an extensive table of contents and a carefully worked out index.

Of the many chapters that one may read with interest and profit, the discussion on fever in the puerperium deserves special mention. After having cited instances of bacterial pyrexia, the author lays stress on fever due to estragenal causes such as constipation, gastro-intestinal irritation, psychical disturbances, earache and sinusitis, urticaria. It is to be hoped that the beginner will heed such wise counsel and carefully weigh all points before resorting to the popular procedure of lavage of the freshly delivered uterus and thereby subjecting his patient to grave and frequently unnecessary risk. In the prevention of eclampsia, the author has been most successful. Only once in 35 years of private practice did a case of toxæmia reach the stage of convulsions. In the treatment of eclampsia, profuse sweating is practiced, but veratrum viride and pilocarpin are condemned. As an anæsthetic for eclamptic patients, *æther* is preferred to either ether or chloroform. *Æther* is a mixture of ether, chloroform, and ethyl chloride in which the latter ingredient secures and maintains the necessary anæsthesia with so small an amount of the anæsthetic that the irritating effect of the small amounts of ether and chloroform is negligible. In patients exsanguinated from an ectopic pregnancy or placenta prævia, transfusion of blood is advocated.

A teacher of wide experience and a humane physician reveals himself in this book, and the student will undoubtedly be stimulated to observe his own cases more carefully and systematically and thus to attain the standard set for him by the author.

¹ CASE HISTORIES IN DISEASES OF WOMEN. By Charles M. Green. A. B. M. D. Boston. W. M. Leonard 1913.

² Surg. Gynec. & Obst. 1915, 25: 500.

Clinical Congress of Surgeons of North America

SEVENTH ANNUAL SESSION

PHILADELPHIA

OCTOBER 23 TO 28, 1916

CLINICAL CONGRESS OF SURGEONS OF NORTH AMERICA

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PLANS FOR THE PHILADELPHIA MEETING

ON the following pages is presented a preliminary schedule of the clinics and demonstrations to be given by the clinicians of Philadelphia during the seventh annual session of the Clinical Congress of Surgeons of North America to be held in that city the week of October 23, 1916. It will be understood that the published schedule is a tentative one and is to be amplified and corrected from month to month as the work of the Committee on Arrangements progresses, so that the final program will fitly represent the clinical work of the Philadelphia surgeons.

The Committee on Arrangements has planned a complete showing of Philadelphia's clinical facilities in every department of surgery, including gynecology, obstetrics, genito-urinary surgery, orthopedics, surgery of the eye, ear, nose and throat, together with many demonstrations on border line subjects. Members of the Congress who were privileged to attend the second session, held in that city in 1914, will recall with great pleasure the splendid clinical program afforded

by the Philadelphia surgeons at that time and will look forward with interest to a second opportunity of visiting that city.

Programs for a series of evening meetings are being arranged by the Executive Committee of the Congress. The presidential meeting takes place on Monday evening, at which time the President elect, Dr. Fred B. Lund of Boston, will deliver the annual address. On the following evenings, excepting Saturday, there will be sessions of the section on general surgery in the Ball Room of the Bellevue Stratford, at which papers will be read by visiting surgeons who have been selected because of their special fitness to discuss the subjects under consideration. A series of meetings for the section on surgery of the eye, ear, nose and throat is also to be arranged for

LIMITED ATTENDANCE

Following the precedent established at the London meeting in 1914 and at the Boston meeting in 1915, attendance at this meeting will be

limited in number. A careful survey of the operating amphitheatres, lecture rooms, and laboratories of the several medical schools and hospitals in Philadelphia, as to their capacity for accommodating visiting surgeons, will be made and the limit of attendance will be based upon the result of this survey. The popularity of these meetings has become so great that the plan of limiting the attendance and requiring advance registration has been devised upon to prevent overcrowding. This plan has worked satisfactorily at the two previous meetings, as it assures accommodations at the clinics for all who hold membership cards.

Within a few weeks an announcement of the plans for the Philadelphia meeting will be sent to all members of the Congress with the advice that advance registration will be required because of the limited attendance. Already a number of applications for membership cards for the Philadelphia meeting have been received at the office of the Secretary General and it is expected that the limit of membership will be reached long in advance of the date of the meeting.

HEADQUARTERS

Headquarters will be established at the Bellevue Stratford where the Ball Room, Clover Room, Red Room, Green Room, and adjacent foyers and smaller rooms have been reserved for the use of the Congress. These rooms are located on the second floor of the hotel and provide ample space for registration rooms and ticket bureau, bulletin boards, etc., the Ball Room being used for the evening meetings.

Headquarters will be open on the afternoon of Saturday, October 21st, and on Sunday, the 22d,

for the registration of members. The program of clinics and demonstrations for Monday will be bulletined on Saturday afternoon, and on each afternoon, beginning Monday, the complete program for the next day's clinics will be posted on bulletin boards in headquarters. A printed program will be issued each morning and special tickets for all clinics and demonstrations will be issued to members at 8 a.m. each day of the session.

SPECIAL TICKETS

The use of special tickets at previous sessions has fully demonstrated the efficacy of this method of providing for the distribution of members among the various clinics. To prevent overcrowding, tickets for any clinic or demonstration are limited in number to the actual capacity of the room in which the clinic or demonstration is to be given. These special tickets will be issued at 8 o'clock each morning for the clinics and demonstrations to be held that day, a complete clinical schedule having been posted on the bulletin board on the afternoon of the preceding day, and a printed schedule of the clinics distributed early each morning.

REGISTRATION FEE

The constitution of the Congress provides that a registration fee shall be required of each member attending an annual meeting, there being no annual dues for members of the Congress. The registration fees provide funds to meet the expense of preparing for and conducting the annual meetings so that no financial burden is imposed upon members of the profession in the city entertaining the Congress.

PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY

KATY W. BALDWIN — Woman's Hospital
 M. BEHREND — Jewish Hospital
 JOHN A. BOGGER — Stetson Hospital
 LEON BRITMAN — St. Agnes Hospital
 J. B. CANNITT — University Hospital
 J. CHALMERS D'Costa — Jefferson Hospital
 HARRY C. DEAYER — Episcopal and Woman's College Hospitals
 JOHN B. DEAYER — German and University Hospitals
 GEORGE M. DORRANCE — St. Agnes Hospital
 E. L. ELIASON — Howard and University Hospitals
 M. FRANKLIN — St. Joseph's Hospital
 CHARLES H. IZZARD — University Hospital
 JOHN GIBSON — Jefferson Hospital
 NATHANIEL GINSBURG — Mt. Sinai and Jewish Hospitals
 L. J. HAMMOND — Methodist Hospital
 CHARLES HANNA — St. Joseph's Hospital
 EDWARD H. HODGE — Presbyterian Hospital
 JOHN I. N. JONES — St. Joseph's Hospital

J. H. JORSON — Presbyterian and Polyclinic Hospitals
 JAMES A. KELLY — St. Joseph's Hospital
 ERNEST LAPLACE — Medico-Chirurgical Hospital
 HIRSH R. LOUY — Philadelphia General Hospital
 EDWARD MARTIN — University Hospital
 BERNARD MENCKE — Stetson Hospital
 GEORGE P. MCLELLER — St. Agnes and University Hospitals
 DAMON B. PREIFFER — University Hospital
 G. G. ROSS — German and Stetson Hospitals
 FRANCES R. SPRAGUE — Woman's Hospital
 MAX STALLER — Mt. Sinai Hospital
 FRANCES T. STEWART — Jefferson Hospital
 WILLIAM J. TAYLOR — St. Agnes Hospital
 T. TURNER THOMAS — University Hospital
 WILLIAM H. TULLER — Jewish Hospital
 H. R. WHARTON — Presbyterian Hospital
 A. D. WHITING — German Hospital
 A. C. WOOD — Howard and University Hospitals

GYNECOLOGY AND OBSTETRICS

Monday

THEO. A. FRICK — Gynecean Hospital — 10 to 11
 BARTON COOKE HIRST and JOHN COOKE HIRST — Howard Hospital — 11
 E. E. MONTGOMERY — Jefferson Hospital — 11 to 12
 JOHN M. FISHER — St. Agnes Hospital — 9 to 11
 WILLIAM D. COLLIN — West Philadelphia General Homeopathic Hospital — 10
 LINA STEWART COGILL — Woman's Hospital — 9
 SARAH H. LOCKREY — Woman's Hospital — 10
 JOHN G. CLARK and staff — University Hospital — 9 to 12

Tuesday

GEORGE W. OSTERBRIDGE — Gynecean Hospital
 BROOKE M. ANSFACH — Gynecean Hospital
 EDWARD P. DAVIS — Jefferson Hospital — 11
 E. E. MONTGOMERY — Jefferson Hospital — 11 to 12
 JOHN H. GIBSON and GEORGE I. SHOFMAKER — Presbyterian Hospital — 12
 JOHN A. MCGLENN — St. Agnes Hospital — 11
 P. BROOKS BLAND — St. Joseph's Hospital
 BARTON COOKE HIRST — University Hospital — 9
 SARAH H. LOCKREY — West Philadelphia Hospital for Women — 11 to 12
 FLEA W. GRIM — Woman's Hospital — 9
 MARIK B. FORWARD — Woman's Hospital — 10

Wednesday

THEO. A. FRICK — Gynecean Hospital — 10 to 11
 BARTON COOKE HIRST and JOHN COOKE HIRST — Howard Hospital — 11
 E. E. MONTGOMERY — Jefferson Hospital — 11 to 12
 JOHN M. FISHER — Philadelphia General Hospital — 10 to 11
 JOHN A. MCGLENN — St. Agnes Hospital — 11
 P. BROOKS BLAND — St. Joseph's Hospital
 J. C. APPLEGATE — Samaritan Hospital — 11 to 12
 BROOKE M. ANSFACH — University Hospital — 9 to 12

CAROLINA M. PEARCE — Woman's Hospital — 10

Thursday

GEORGE W. OSTERBRIDGE — Gynecean Hospital
 JOHN G. CLARK and staff — University Hospital — 9 to 12
 BROOKE M. ANSFACH — Gynecean Hospital
 JOHN M. FISHER — Jefferson Hospital — 12 to 1
 JOHN H. GIBSON and GEORGE I. SHOFMAKER — Presbyterian Hospital — 12
 JOHN A. MCGLENN — St. Agnes Hospital
 P. BROOKS BLAND — St. Joseph's Hospital
 WILLIAM D. COLLIN — West Philadelphia General Homeopathic Hospital — 10
 SARAH H. LOCKREY — West Philadelphia General Homeopathic Hospital — 11 to 12
 M. LUISE DITZ — Woman's Hospital — 9
 SARAH H. LOCKREY — Woman's Hospital — 10

Friday

THEO. A. FRICK — Gynecean Hospital — 10 to 11
 BARTON COOKE HIRST and JOHN COOKE HIRST — Howard Hospital — 11
 JOHN A. MCGLENN — St. Vincent's Hospital
 MARY T. MILLER — Woman's Hospital — 9
 CATHERINE MACFARLANE — Woman's Hospital — 10

Saturday

JOHN G. CLARK and staff — University Hospital — 9 to 12
 P. BROOKS BLAND — Jefferson Hospital — 11 to 12
 BARTON COOKE HIRST — University Hospital — 9

Days to be announced

WM. R. NEWBORN — Methodist Hospital
 STEPHEN E. TRACY — Stetson Hospital
 GEORGE M. BYRD — Medico-Chirurgical and Philadelphia
 I have in Charity Hospital
 FREDERICK C. SMITH — Methodist Hospital

ORTHOPEDIC SURGERY

Monday

J. T. RICH and staff — Methodist Hospital — 4 to 5
A. P. C. ASHURST and A. B. GILL — Episcopal Hospital — 2 to 4

Tuesday

J. T. RICH and staff — Methodist Hospital — 4 to 5
H. A. WILSON and staff — Jefferson Hospital — 11 to 1
W. J. TAYLOR and staff — Orthopedic Hospital — 11 to 1
J. F. MANN — Medico-Chirurgical Hospital — 2 to 3
HARRY HUDSON and staff — Samaritan Hospital — 2 to 4
G. G. DAVIS and staff — University Hospital — 2 to 3

Wednesday

J. T. RICH and staff — Methodist Hospital — 4 to 5
A. P. C. ASHURST and A. B. GILL — Episcopal Hospital — 2 to 4
G. G. DAVIS and staff — University Hospital — 2 to 4

Thursday

J. T. RICH and staff — Methodist Hospital — 4 to 5
H. A. WILSON and staff — Jefferson Hospital — 11 to 1
G. G. DAVIS and staff — Orthopedic Hospital — 11 to 1
J. F. MANN — Medico-Chirurgical Hospital — 1 to 3
J. K. YOUNG and staff — Polyclinic Hospital — 2 to 5
G. G. DAVIS and staff — University Hospital — 2 to 3

Friday

J. T. RICH and staff — Methodist Hospital — 4 to 5
G. G. DAVIS — Widener School — 2 to 4
G. G. DAVIS and staff — University Hospital — 2 to 3
J. K. YOUNG and C. H. GRAY — Philadelphia General Hospital — 2 to 3

Saturday

J. T. RICH and staff — Methodist Hospital — 4 to 5
A. P. C. ASHURST and staff — Orthopedic Hospital — 9 to 11
H. A. WILSON and staff — Jefferson Hospital — 11 to 1

GENITO-URINARY SURGERY

L. T. ASHCRAFT — Mahemann and Woman's Homeopathic Hospitals
H. M. CHRISTIAN — Medico-Chirurgical Hospital
H. R. LOUX and staff — Jefferson Hospital
T. R. NELSON — University Hospital

F. H. SITTA — Philadelphia General Hospital
F. H. SITTA and staff — University Hospital
B. A. THOMAS — Polyclinic Hospital
A. A. UMLE and WILLIAM MACKINNEY — German Hospital — Monday and Friday

ROENTGENOLOGY

Monday

SIDNEY FELDSTEIN — Jewish Hospital — 3 to 4 Obscure and interesting fractures
W. S. NEWCOMB — Presbyterian Hospital — 2 to 3 Bone lesions Sinus cases (in conjunction with Dr Stauffer)
GEORGE L. PFANLIER — Medico-Chirurgical Hospital — 2 30 to 3 30 Roentgentherapy in the treatment of deep seated malignant disease

Tuesday

DAVID R. BOWEN — Pennsylvania Hospital — 1 to 2 Fractures
FREDERICK C. HUTTON — 1438 N. 15th St — 10 to 12 Organic lesions of the stomach and duodenum
W. F. MANGES — Jefferson Hospital — 2 to 3 Pycloscopy and pyclography
W. S. NEWCOMB — Presbyterian Hospital — 2 to 3 Bone lesions Sinus cases (in conjunction with Dr Stauffer)
GEORGE L. PFANLIER — Medico-Chirurgical Hospital — 2 30 to 3 30 Roentgen diagnosis of gastric and duodenal lesions Lantern slide demonstration

Wednesday

W. F. MANGES — Jefferson Hospital — 2 to 3 Fluoroscopic of the gastro-intestinal tract

W. S. NEWCOMB — Presbyterian Hospital — 2 to 3 Bone lesions Sinus cases (in conjunction with Dr Stauffer)
GEORGE L. PFANLIER — Medico-Chirurgical Hospital — 2 30 to 3 30 Roentgen diagnosis of gall stones
DAVID R. BOWEN — Pennsylvania Hospital — 1 to 2 Bone and joint diseases
W. K. FISHER — Stetson Hospital — Joint diseases and radiography of the urinary tract

Thursday

DAVID R. BOWEN — Pennsylvania Hospital — 1 to 2 Surgical diseases of the thorax
SIDNEY FELDSTEIN — Jewish Hospital — 3 to 4 Tuberculosis of the lungs
FREDERICK C. HUTTON — St. Mary's Hospital — 3 to 5 Intestinal pathology
W. F. MANGES — Office — 2 to 3 Brain tumor and intracranial lesion
W. S. NEWCOMB — Presbyterian Hospital — 2 to 3 Bone lesions Sinus cases (in conjunction with Dr Stauffer)

Friday

DAVID R. BOWEN — Pennsylvania Hospital — 12 to 1 The management of small and medium sized hospital roentgen laboratories

- W F MANGES—Office—2 to 3 Roentgen examination of teeth as an aid to surgical diagnosis
 W S NEWCOMB—Presbyterian Hospital—2 to 3 Bone lesions Sinus cases (in conjunction with Dr Stauffer)
 GEORGE E PFAHLER—Medico-Chirurgical Hospital—2 30 to 3 30 Electro-coagulation in the treatment of malignant disease
 M K FISHER—Stetson Hospital—Joint diseases and radiography of the urinary tract

Saturday

- DAVID R BOWEN—Pennsylvania Hospital—12 to 1 The management of small and medium sized hospital roentgen laboratories
 W S NEWCOMB—Presbyterian Hospital—2 to 3 Bone lesions Sinus cases (in conjunction with Dr. Stauffer)
 Days to be Announced
 HENRY K. PANCOAST—University Hospital—9 to 10, Radium therapy, 3 to 4; Gastro-intestinal tract

SURGERY OF THE EYE

Monday

- WILLIAM CAMPBELL POSEY—Howard Hospital—2
 S LEWIS ZIEGLER—Wills Eye Hospital—2
 SAMUEL D RISLEY—Wills Eye Hospital—2
 McCUNEY RADCLIFFE—Wills Eye Hospital—2
 WILLIAM M SWEET—Wills Eye Hospital—3
 PAUL PONTIUS—Wills Eye Hospital—2
 L. PETER—Polychinic Hospital—1
 PAUL PONTIUS—St. Joseph's Hospital—3 30
 MIRIAM M BUTT—Woman's Hospital—2
 MARY BUCHANAN—Woman's College Hospital—2
 FREDERICK KRAUSS—Episcopal Hospital—2
 LEWIS LOVE—St. Mary's Hospital—3
 AARON BRAY—Jewish Hospital—3
 E D FUNK—Jefferson Hospital—2

Tuesday

- E D FUNK—Jefferson Hospital—2
 WILLIAM T SHOENAKER—Pennsylvania Hospital—2
 GEORGE S CRAMPTON—Pennsylvania Hospital—2
 WILLIAM W SPEAKMAN—Hahnemann Hospital—2
 WILLIAM CAMPBELL POSEY—Wills Eye Hospital—2
 P N K SCHWENK—Wills Eye Hospital—1 30
 T B HOLLOWAY—Polychinic Hospital—1
 MARY BUCHANAN—Woman's Hospital—2
 G ORAM RING—Episcopal Hospital—3
 AARON BRAY—Lebanon Hospital—2
 H F HANSELL—Philadelphia General Hospital—2 30
 McCUNEY RADCLIFFE and J M GRISCOM—Presbyterian Hospital—2
 WILLIAM ZENTMAYER—Wills Eye Hospital—2
 G F DE SCHWELTZ—University Hospital—3
 G F DE SCHWELTZ—University Hospital—5

Wednesday

- CHARLES W LEFEBVRE and S J GITTELSON—Mt. Sinai Hospital—3
 L D FUNK—Jefferson Hospital—2
 L WEBSTER FOX—Medico-Chirurgical Hospital—1
 S LEWIS ZIEGLER—Wills Eye Hospital—2
 SAMUEL D RISLEY—Wills Eye Hospital—2
 McCUNEY RADCLIFFE—Wills Eye Hospital—2
 WILLIAM M SWEET—Wills Eye Hospital—2
 PAUL PONTIUS—Wills Eye Hospital—2
 WENDELL REBER—Polychinic Hospital—1
 WILLIAM T SHOENAKER—German Hospital—1
 CHARLES J JONES—St. Joseph's Hospital—3
 MIRIAM M BUTT—Woman's Hospital—2
 MARY BUCHANAN—Woman's College Hospital—2
 H G GOLDBERG—Episcopal Hospital—2
 LEWIS LOVE—St. Mary's Hospital—3
 J C KNIFF—Jewish Hospital—2

Thursday

- PHILIP H MOORE—Methodist Hospital—3
 J A KEARNEY—St. Agnes Hospital—3
 J C KNIFE—Jefferson Hospital—3
 L D FUNK—Jefferson Hospital—2
 WILLIAM T SHOENAKER—Pennsylvania Hospital—2
 GEORGE S CRAMPTON—Pennsylvania Hospital—2
 WILLIAM CAMPBELL POSEY—Wills Eye Hospital—2
 P N K SCHWENK—Wills Eye Hospital—1 30
 WILLIAM ZENTMAYER—Wills Eye Hospital—2
 L. APPELMAN—Polychinic Hospital—1
 MARY BUCHANAN—Woman's Hospital—2
 FREDERICK KRAUSS—Episcopal Hospital—2
 AARON BRAY—Lebanon Hospital—2
 JAMES THORINGTON and J M GRISCOM—Presbyterian Hospital—2
 G F DE SCHWELTZ and E A SHUMWAY—University Hospital—3

Friday

- H F HANSELL and WILLIAM M SWEET—Jefferson Hospital—2 45
 S LEWIS ZIEGLER—Wills Eye Hospital—2
 SAMUEL D RISLEY—Wills Eye Hospital—2
 McCUNEY RADCLIFFE—Wills Eye Hospital—2
 PAUL PONTIUS—Wills Eye Hospital—2
 F A SHUMWAY and H M LANGDON—Children's Hospital—2
 WENDELL REBER—Polychinic Hospital—1
 L. PETER—Polychinic Hospital—5
 WILLIAM T SHOENAKER—German Hospital—1
 CHARLES J JONES—St. Joseph's Hospital—3
 G ORAM RING—Episcopal Hospital—2
 LEWIS LOVE—St. Mary's Hospital—3
 MIRIAM BUTT—Woman's Hospital—2
 L D FUNK—Jefferson Hospital—2
 AARON BRAY—Jewish Hospital—3

Saturday

- F D FUNK—Jefferson Hospital—2
 WILLIAM T SHOENAKER—Pennsylvania Hospital—2
 GEORGE S CRAMPTON—Pennsylvania Hospital—2
 P N K SCHWENK—Wills Eye Hospital—1 30
 WILLIAM ZENTMAYER—Wills Eye Hospital—2
 H G GOLDBERG—Episcopal Hospital—2
 AARON BRAY—Lebanon Hospital—2
 WILLIAM CAMPBELL POSEY—Wills Eye Hospital—2

SURGERY OF THE EAR, NOSE AND THROAT

Monday

CHARLES G. GRAYSON — University Hospital — 2
 R. SKILLERN — Medico-Chirurgical Hospital — 2
 I. JONES — Blockley Hospital — 2
 MARGARET BUTLER — Woman's Medical College Hospital — 2 to 4

Tuesday

I. R. PACKARD — Pennsylvania Hospital — 2
 D. B. KYLL — Jefferson Hospital — 12
 R. SKILLERN — Medico-Chirurgical Hospital — 2

Wednesday

WALTER ROBERTS — Polyclinic Hospital — 2
 RALPH BUTLER — Polyclinic Hospital — 3
 R. SKILLERN — Medico-Chirurgical Hospital — 2

MARGARET BUTLER and LAURA HUNT — Woman's Hospital — 2 to 4.

Thursday

GEORGE M. COATTS — Polyclinic Hospital — 1

Friday

SETH MACCLEN SMITH — Jefferson Hospital — 1 30
 GEORGE M. COATTS — Pennsylvania Hospital — 1
 MARGARET BUTLER and LAURA HUNT — Woman's Hospital — 2 to 4

Days to be announced

ARTHUR WATSON — Polyclinic Hospital
 G. HICSON MACCLEN — Polyclinic Hospital
 ALEXANDER RANDALL — University Hospital
 E. B. GRAYSON — Medico-Chirurgical Hospital

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ROENTGEN-RAY DIAGNOSIS OF GAS AND PUS INFECTIONS AS COMPLICATIONS OF WOUNDS WITH DEEPLY BURIED BULLETS OR SHELL FRAGMENTS

By GEORGE G. DAVIS, A.B. M.D., CHICAGO

Operating Surgeon, Twenty Third General Hospital, British Expeditionary Force, Flanders, France

IT is a routine procedure at the Twenty third General Hospital to roentgen ray all bullet or shell wounds, when the missile is suspected of remaining in the body. Also it is our custom to have two views, an anteroposterior and a lateral before starting any surgical interference aiming to remove the foreign body.

As a large percentage of our cases are bullet or shell injuries we have an excellent opportunity of studying and drawing conclusions from our roentgen-ray findings.

In all cases in which the roentgen ray has shown a 'halo like' shadow about the missile we have found clinically, at the operating table and in the laboratory, evidence of an infection caused by gas and pus forming organisms.

The roentgen ray pictures of these cases may best be described by dividing them into two groups. In the first the gas and pus infection is local or limited and a single 'halo like' shadow is noted about the bullet some times encircling it like a halo or more often extending in one or more directions from it either above or below or laterally (Fig. 3). This shadow may have a diameter of half an inch or as large as two inches. The local picture may be composed of a number of small, irregularly round or elongated shadow areas (Figs. 4 and 5) in close relation to the

bullet or extending along the track of the missile.

The roentgen ray picture in the second group of cases that is in those cases in which the gas and pus infection is more or less extensive shows a shadow similar to that noted in the first group plus shadows extending upward and downward for a considerable distance (Figs. 1 and 2), according to the extent of the infection.

Clinically these cases early manifest definite symptoms. The patient complains of severe pain in the region of the missile. He feels sick, weak, and is very restless. There is a marked rise in temperature and increase in the pulse rate. Locally one finds a swelling which may be confined to the area about the missile or in the more severe or extensive cases the entire diameter of the limb may be increased and indurated. A point of exquisite tenderness will at times help the operator to localize the missile. On palpation with moderate pressure a crackling sensation—crepitation—is imparted to the examining hand and gas bubbles may be seen to escape through pus at the wound of entrance of the missile.

At operation one finds along the entrance wound and about the missile, a generous pocket of thick pus, which has a pinkish color and gives a characteristic gas odor. This pus may be localized about the missile or in the



Fig 1 Showing a halo like shadow of gas about a fragment of shell, also longitudinal shadows of gas in the intermuscular planes. This patient died of gas bacillus infection.



Fig 2 Same case as Fig 1 showing shell fragment and longitudinal shadows of gas in the intermuscular planes. This patient died of gas bacillus infection (bacillus aerogenes capsulatus).

more severe cases extend up along the intermuscular planes.

The laboratory examination of the pus shows in about 95 per cent of the cases the

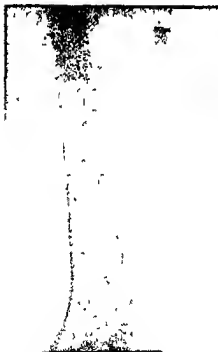


Fig 3 Showing halo like shadow of gas and pus about the fragment of shell. The shadow here is mostly below the muscle.



Fig 4 Showing a number of small irregularly round or

Fig 4 elongated shadows of gas and pus above and anterior to shrapnel bullet.



Fig 5 Showing a number of small irregularly round or elongated shadows of gas and pus anterior to a fragment



Fig 6

Fig 6 Showing a serpent like shadow of gas, which extends above and below a fragment of shell

Fig 7 Showing shell fragments and extensive gas infiltration between muscle bundles especially about the lower third of femur. The infection involved also the



Fig 7

upper third of the thigh and extended to the abdomen. The patient died 48 hours after injury.

Fig 8 Same patient as in Fig 7 showing gas infiltration in upper third of thigh, especially on lateral aspect. Patient died 48 hours after injury.



Fig 8

bacillus aerogenes capsulatus, with accompanying pus organisms. Of the latter the staphylococcus is the most frequent. Other associated organisms are the streptococcus pyogenes, colon bacillus, tetanus bacillus. The colon bacillus is especially common in wounds about the buttocks. The tetanus bacillus is at times found in the pocket of pus, but clinical symptoms of tetanus do not follow.

We have found the roentgen ray picture

here described so constantly in cases which give this same clinical, laboratory, and operating room finding that we believe it to be of considerable value and importance.

In cases where the missile has been allowed to remain in the body and clinical symptoms develop, we request a roentgen organ to see if this finding has developed. If this picture is encountered when raying to locate a missile, we consider it an indication for urgent surgical interference.

FRACTURE OF THE OS CALCIS

By BENJAMIN F. LOUNSBURY, M.D., CHICAGO

THE subject of fracture of the os calcis might well be discussed under the title of unrecognized and neglected fractures. During the past four years 21 cases of fracture of the os calcis have come to me, most of them incorrectly diagnosed. Interest in these cases led me to review the literature and acquire other data from unpublished sources. In this latter connection I am indebted to Dr. Hollis E. Potter for the privilege of seeing his collection of more than one hundred radiograms of fractured os calcis, gathered during his long experience as radiographer of Cook County Hospital, the Presbyterian Hospital, and from other sources. Through his courtesy I am using some of his radiograms to help illustrate this article.

Until a comparatively recent date fracture of the os calcis was considered a rare condition. The growing practice among surgeons of submitting all doubtful injuries to the X ray has shown that many conditions about the foot and ankle at first looked upon as sprains, were in reality, fractures. This has been especially true with reference to the calcaneum. One author¹ estimates that fractures of this bone form 2 per cent of all fractures and that in 75 per cent of the cases reviewed by him, the first diagnosis was wrong. Von Bergmann quotes Fhret as claiming that 2 per cent of all fractures are of the os calcis and quotes Golebiewski as claiming that they form 4 per cent of all accident cases. Out of one thousand cases of fracture which I have treated in the past four years 21 or 2.1 per cent were fractures of the os calcis. Five cases have come to my care within the past five months, 2 immediately following injury and 3 that had been treated for some time as sprained ankles. It is because of the unusual disabling after effects and the errors in diagnosis that greater care should be exercised in examinations of injury of the foot and ankle and a better plan of treatment instituted when once the condition is known

The mechanical forces concerned in these fractures vary with the pathological conditions produced. Architecturally, the calcaneum is constructed much like a cantilever bridge, the tuberosity and the cuboid articulation being the points of support. The intervening space is spanned with filaments of bone so arched as to give the maximum carrying strength. This structure is shown in Fig. 1, which represents a normal condition. The astragalus which is a much denser bone than the calcaneum, articulates with the latter by a convex, concave articulation. The part of the astragalus which articulates in the concave facet of the calcaneum fits into it like a wedge with the apex pointing downward directly beneath and in line with the shaft of the tibia. (a) As the great majority of fractures are produced by falling from a height, landing on the feet, there is a tendency for this harder wedge-like portion of the astragalus to drive through the calcaneum at this point especially if the foot be everted when landing. The resistance of the object on which the foot lands tends to drive the posterior fragment upward and backward. (b) The bone may be fractured by muscular strain as reported by Raymond Spear² in which the contraction of the muscles of the calf pulled off the tuberosity and drew it upward and backward with the Achilles tendon. (c) A smaller percentage of fractures result from crushing between two opposing forces as is sometimes seen in elevator accidents when the foot is caught between the floor of the elevator and the shaft, or when heavy wheels pass over the foot. (d) In most of the injuries there is probably a combination of compression and muscular strain. In Fig. 5 it would seem that the plantar fascia and muscles arising from the calcaneum had combined with the force of the falling body to fracture the tubercle and pull it forward. There is great variation in the pathological conditions found, usually more than one line of fracture exists.

¹ Leonard W. Ely, *Ann. Surg. Phila.* 1907, 7, number² *U. S. Navy Med. Bull.* 1910, 14, 359



Fig. 1
Fig. 3

1 In the great majority the main line of fracture is through the concave facet beneath the wedge like convex facet of the astragalus. From this point there may be one or several lines of fracture vertical or longitudinal or obliquely backward. The mass of bone posterior to this point is usually driven upward and backward (see Fig. 4).

2 Frequently the main line of fracture runs vertically from just in front of the tuberosity beneath to a point just behind the posterior border of the convex astragalus articulation with displacement upward of the posterior fragment (see Figs. 6, 7 and 9). The sustentaculum tali may be fractured by a sudden inversion of the heel the line of cleavage being in a vertical plane which passes through the longitudinal axis of the



Fig. 2
Fig. 4

calcaneum at the point where the sustentaculum tali begins to project from the medial surface. Such condition is shown in Fig. 15.

3 Of less frequent occurrence is the tear fracture. This occurs from muscular and tendon strain resulting in the tearing off of a portion or all of the tuberosity, or a chip from lateral surface. It may result from contraction of the calf muscles in which instance a portion of the bone and the attachment of the Achilles tendon are drawn upward (see Fig. 3). It may result from strain of the plantar fascia and muscles, tearing off and displacing forward the portion of the tuberosity to which they are attached (see Fig. 5), or it may result from strain on the calcaneofibular ligament with tearing off of a portion of the lateral surface of the calcaneus.



Fig. 2
Fig. 3

Fig. 4
Fig. 5

4 There may be a combination of two or more of these types resulting in comminution of the bone (see Figs. 2 and 14)

5 Any of these forms may be compound. In recent cases there is usually considerable damage to the soft parts resulting in hematoma and ecchymosis. In any of the types of fracture enumerated there may be marked or very slight displacement of the fragments or in some instances fracture without displacement (see Fig. 13). In most cases impaction to a greater or less extent exists.

In discussing signs and symptoms it is necessary to consider them from the standpoint of recent and old injuries. In recent cases the patient usually presents a swollen, discolored heel and ankle. Depending on the violence of the injury there may or may not be broadening of the heel flattening of the

longitudinal arch of the foot sinking of the malleoli eversion of the heel loss of concavity on each side of the tendon Achilles and crepitation on manipulation. Pain is the chief complaint and this is aggravated by attempt to stand on the foot or by manipulation. In old cases the patient complains of pain in the instep under the heel or under the external malleolus. The foot usually shows a flattening of the longitudinal arch, broadening and eversion of the heel, loss of concavity on both sides of the tendon Achilles sinking of the malleoli especially the internal one which is unusually prominent.

The diagnosis without a radiogram is difficult especially in recent cases. Ehret's statistics quoted by Von Bergemann show that out of 47 cases only 3 were correctly diagnosed. Other statistics show practically no better



Fig 9



Fig 10

results. Before the general use of the X ray in injuries, there was justification for these errors, but today mistaken diagnosis should be the exception. Without a radiogram one can hardly be sure of conditions in any case. With the radiogram all doubt is eliminated. The differential diagnosis lies between fracture of the os calcis and other injury about the ankle, and here again the radiogram is the court of last appeal. Judging from past experiences it would have been better for the patient had it been the first. It not only makes the diagnosis as to the presence of fracture but gives us the only reliable information on which to select proper treatment.

Treatment of these conditions if we may judge by results has in the past been very unsatisfactory, either through lack of early diagnosis, or because of inadequate management. Cabot and Binney¹ reviewing 111 cases in the Massachusetts General Hospital admitted over a period of fifteen years say that results thus far in treatment, are not good. Ely² reviewing seventeen cases says results with the usual treatment are bad. I have heard the remark that about all that can be done for a fractured heel is to make a diagnosis and a bad prognosis. When we consider that in most cases the true conditions are not known until healing with some permanent disability has occurred (see Figs 10 and 14) the importance of early diagnosis as a prophylactic measure becomes evident.

Because of the great number of neglected cases treatment must be considered from the standpoint of old and recent injuries. Treatment must be adapted to the different conditions presented. In tear fractures suture with kangaroo tendon followed by immobilization with relaxation of the muscles of the calf and the plantar fascia and muscles. A great majority of recent injuries present a fracture with displacement backward and upward of the posterior portion attached to the Achilles tendon. In many instances considerable impaction has taken place. This results in flattening of the longitudinal arch of the foot. The fragment is held in malposition by contraction of the calf muscles and the impaction. The ordinary practice of trying to manipulate this fragment into position has failed in every instance in which I have tried it. Following Cabot's suggestion I have been able to secure reduction by passing a urethral sound above the fragment in front of the Achilles tendon and making downward traction while an assistant makes counter force on the anterior end of the bone, by pulling up under the instep with a piece of gas pipe placed transversely to the longitudinal arch. This generally gives excellent reduction. The Achilles tendon is then severed to overcome the pull of the calf muscles and the heel and ball of the foot drawn toward the center, elevating the arch. A plaster cast extending to the knee and elevated in the arch is then applied. While the cast is hardening pressure



Fig 11
Fig 12

is made upward in the arch and the cast is indented laterally above the posterior fragment. This cast is left on for about four weeks and then removed and passive motion, massage, and hot foot soaks given daily. The patient is not allowed to put any weight on the feet for ten weeks. He is then fitted with arch support and begins by the aid of crutches to gradually put weight on the foot.

Figures 11 and 12 show a case treated in this manner. The patient was seen within an hour of the accident; both heels had been fractured by a fall of about twenty-feet landing on a concrete pavement. Radiograms showed the condition seen in Fig 11. Under general anesthesia reduction was attempted by manipulation. Failing in this the patient



Fig 13
Fig 14

was put to bed with ice packs about the ankle. Four days later when swelling had somewhat subsided a general anesthetic was given and the treatment as above outlined carried out. Figure 12 shows the end-result. We have applied this method in three cases with good anatomical and functional results.

Von Bergemann in discussing treatment, says: "If the fragment cannot be held in place with a splint, it should be nailed in place through the skin as recommended by Gussenbauer." Such treatment seems objectionable for two reasons. First the danger of necrosis and infection owing to the poor blood supply to the heel (this was recognized even in the time of Hippocrates who described fracture of the os calcis and cautioned that if improperly

treated might result in gangrene) Second, mechanically, great strain is put on the single line where bone contacts with the nail and pressure necrosis with ultimate displacement of the fragment is likely to result In greatly comminuted fractures with lateral broadening Cotton¹ recommends re-impaction with a mallet by hammering the fragments together from the lateral aspect

In compound and comminuted fractures it is sometimes necessary to remove some of the fragments Leriche² reports a comminuted fracture in which he resected the greater portion of the bone and says that he obtained excellent functional results Liendcrath³ reports a case in which the posterior tip with the tendon attachment was torn off This he treated by suture In old cases which constitute the large majority of patients, the surgeon is consulted to obtain relief from disabling pain The pain is usually under the external malleolus, in the instep, under the point of the heel or in the sole of the foot Frequently a proper fitting arch support will relieve the pain in the instep which is due to flattening of the longitudinal arch For pain in the sole of the foot Cotton⁴ recommends a pad under the heel thus lifting pressure from structures in the sole of the foot Pain under the external malleolus is due to broadening of the os calcis from displaced fragments or callus This can be relieved only by chiseling away the impinging portion of the os calcis Pain under the heel is caused by callus or misplaced fragments of bone which should be removed (Figs 4, 5, and 8) To restore the normal contour of the plantar surface and bring the posterior end of the os calcis down Gleich has recommended an operation in which a wedge shaped piece of bone is removed from the under surface, thus bringing the posterior end downward and forward

The prognosis from most accounts in the literature is bad Von Bergemann says "If the fragment cannot be properly reduced the functional disturbance is usually permanent, the patient complains of pain in the sole



Fig. 15

of the foot the extensor muscles atrophy and hard work is impossible" Cabot and Binney estimate average disability at from six months to two years It must be remembered that these opinions are based on conditions that existed as far back as fifteen and twenty years ago when radiograms were not so generally used as they are today It would seem with the better facilities for diagnosis and better methods for treatment that we might hope for great improvement in the results in the future

Responsibility for the majority of bad results is largely chargeable to lack of thoroughness in examination of foot and ankle injuries and more than anything else to neglect of the radiogram and to inadequate methods of treatment when the condition is recognized

BIBLIOGRAPHY

- ABBE, T. Case of fracture of the os calcis Washington M Ann 1905, iv 120
 BATLT Fracture transverse du calcaneum Marseille med 1909, xlv, 162
 BEESLY and PRICE Avulsion fracture of the os calcis J Emb M J, 1914 vi, 436
 BINNEY JOHN J Manual of Operative Surgery Philadelphia 1913
 BRANDIS VICTOR D Ueber die Behandlung des Kompressionsfrakturen des Calcaneus Berlin 1908
 CABOT and BINNEY Fractures of the os calcis and astragalus (diagnosis and treatment) Ann Surg, Phila 1907 xl
 CABLES, A and MAYOR S Fracture of the greater process of the calcaneum Practitioner, Lond, 1902, Dec, 631
 CHARRANON, A and JACON F Les fractures du calcaneum Gaz d hop Par 1905, lxxviii, 975
 CHOYCE C C A System of Surgery New York 1914 iii 670

¹ Dislocations and Joint Fractures 1910

² Leriche Lyon med 1904 ccxv 148

³ Ann Surg Phila 1904, xl 365

⁴ Dislocations and Joint Fractures 1910

- COTTON, I. J. and WILSON, I. T. Fractures of the os calcis (crushing fractures). Boston M & S J., 1908, clix, 559.
- COTTON, Frederick J. Dislocations and Joint Fractures (Os calcis fractures, cause, symptoms, diagnosis, treatment and results, with 43 illustrations and sketches). Philadelphia and London, 1910.
- DUBOIS, LOUIS. Contribution à l'étude des fractures du calcaneum avec documents radiographiques. Thèse de doct. Par., 1906, No 217.
- DESTOT. Fracture du calcaneum (type Lager). Lyon chir. 1908, i, 541.
- ELSTONBATH, D. N. Fractures of the os calcis. Illinois M J. 1904, vi, 58.
- ELSTONBATH, HENRI N. Fractures of the tarsal bones. Ann Surg. Phila., 1905, xli, 311.
- ELSTONBATH, W. Old fracture of the tarsus. Ann Surg. Phila., 1907, xli, 69.
- FRANÇOIS, CHARLES. Classification des fractures du calcaneum. Montpellier 1913.
- GAUTHIER, M. Fractures du calcaneum par enfoncement. Thèse de doct. Par. 1901, No 12.
- HOWARD, HENRI. The Fracture of Surgery. London 1914, p. 478.
- JUVAR, E. Fracture par arrachement de la tubérosité du calcaneum. Presse méd. 1912, xii, 609.
- LECOQ, SIMON, T. Une méthode de traitement des fractures du calcaneum. Lille 1900.
- LEUTH. Fracture compliquée du calcaneum resection immediate guérison avec excellent résultat fonctionnel. J. n. med. 1913, cix, 1183.
- MOXBON, H. L'œchymose plantaire dans les fractures du calcaneum. Presse méd., 1912, xi, 1082.
- PATEL, LOUIS. Contribution à l'étude des fractures du calcaneum. Paris 1911.
- PRINCIP, J. H. WARTHE. Fractures and their Treatment. London 1910, p. 221.
- RECHTER, J. P. L. M. Contribution à l'étude des fractures du calcaneum. Nancy 1912.
- RIEU, C. Le diagnostic des fractures du calcaneum. Bull. méd. chir. d'accid. du travail, 1908, i, 161.
- SEYMOUR, CHARLES L. The Treatment of Fractures. Philadelphia 1912, p. 545.
- SOUVER, J. Celles calcaneusfrakturen. Wied. med. Presse, 1906, xliii, 1137.
- SOUTHWELL, P. and KILGUS, A. Fractures du calcaneum (fractures scéscies). Rev. de chir., 1913, xliii, 477.
- SPEAR, R. Fracture of epiphysis of os calcis by muscular contraction. U. S. Navy M. Bull., 1910, iv, 181.
- STIMSON, LEWIS A. A Practical Treatise on Fractures and Dislocations. New York 1911, p. 450.
- TIER, G. Fracture du calcaneum (recherches histologiques). Bull. méd. chir. d'accid. du travail, 1908, i, 176, 341.
- VON BERGMANN. vol. iii, 746.
- VORCKEL. Zur Lehre von der Fraktur des Calcaneus. Deutsche Zeitschr. f. Chir., 1906, lxxviii, 173.
- WESTPHAL, C. Neuere Beobachtungen über die Calcaneusfraktur. Beitr. z. klin. Chir., 1912, lxxxii, 410.
- WIKENSKY, ABRAHAM O. Sprain fracture of the os calcis. Med. Rec., 1912, Mar 17.
- WOLFE and HANAY. Fracture horizontale du calcaneum. Bull. et méd. Soc. anat. de Par., 1912, lxxxvii, 97.

THE ORIGIN OF HYPERNEPHROMA OF THE KIDNEY¹

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IN view of the confusion and doubt still existing in regard to the nature and origin of the so called hypernephromata of the kidney, I feel justified in reporting the results of a study of 34 of these tumors made with the purpose of finding evidence pointing to a definite origin. The tumors studied were collected from this and the Bellevue Hospital pathological laboratories and show, without exception macroscopic and microscopic features that have justified the diagnosis of "hypernephroma." There is nothing special about the method of study except, perhaps, that emphasis was laid on a thorough search of the respective clinical histories and autopsy records for the presence of sex abnormalities and on a close comparative study of the different histological features of each tumor with the view of determining its primary structure as distinguished from appearances due to secondary degenerative or malignant changes. The latter object was accomplished by the tedious labor of making innumerable frozen sections from practically all parts of each tumor the frozen section method having been adopted in order to make possible the use of universal fat stains.

The theories of origin of renal hypernephromata have been discussed so fully in recent publications (1) that it is unnecessary to review them in detail. It is sufficient to state that the theory formulated by Grawitz (2) that they develop from adrenal rests in the capsule of the kidney still prevails in textbook teaching and with probably the majority of clinicians and pathologists. The conclusions reached by nearly all writers who have studied the question at first hand agree however with the hypothesis first formulated by Sudeck (3) and later supported by Stock, namely that they are of renal origin though there is a difference of opinion among these authors as to the particular structure of the kidney from which they arise.

As I have kept constantly in view in deter-

mining evidence as to tumor origin the traditional arguments for and against each of these theories, it may be well for the sake of clearness to restate them briefly.

1 *The "adrenal rest" origin.* The chief argument for this hypothesis is found in the striking resemblance of the tumor-cells to those of the adrenal cortex together with their difference from those of the renal tubules. The fact that the position of the tumor—usually immediately beneath the renal capsule—corresponds with that of "supposed" adrenal rests though formerly cited in support of the theory is now regarded as of little if any significance.

Against this hypothesis the chief facts are

a The difference histologically, between epithelial tumors of the adrenal cortex and hypernephromata of the kidney. In the former the highly reticulated character of the cells as well as tubular and papillary formations is absent the very few so called exceptions recorded being of doubtful character.

b Clinical differences between adrenal and renal hypernephromata. First, as to age of incidence adrenal hypernephromata occur nearly always in the young while hypernephroma of the kidney is found in adults with increasing frequency after the age of 35 years. Second sex abnormalities constitute a usual accompaniment of adrenal hypernephroma whereas up to the present time no symptoms of this nature have been described in connection with hypernephroma of the kidney.

c The frequency of hypernephroma of the kidney when compared with the rarity of true adrenal rests in the kidney.

2 *The renal origin theory.*

a It is claimed that it would be a strange anomaly were the most common primary neoplasm of the kidney of foreign origin.

b It has been shown by Stock, Zehbe (4) and others that renal tubules under certain conditions grow in solid columns and that



Fig. 1. Microphotograph (low power) of Case 1, Group 1.

the cells are capable of developing the "hypernephroid" character.

c. It is further claimed that the papillary and cystic formations so frequently seen in renal hypernephromata could only arise from a structure that is fundamentally tubular—in this instance, the kidney.

d. It is claimed by Stoerk that the hypernephroma-cells possess characters as to appearance and cell contents that are foreign



Fig. 3. Microphotograph (low power) of a tumor nodule growing from the nest of adrenal composite situated on the inner surface of the kidney midway between the upper pole and the hilus. The dark columns at the top represent well preserved cords of adrenal cortical cells appearing black in the picture because of the presence of pigment (Case 2, Group 1).



Fig. 2. High power drawing of Fig. 1.

to the adrenal but which, under certain conditions, are found in the cells of the uriniferous tubules.

The tumors in our collection can be divided into two general groups; those which show positive evidence of being neoplasms of either misplaced or accessory adrenal tissue, and those which show decided evidence of renal origin.

GROUP I—ADRENAL ORIGIN

In this group there are two tumors which on account of certain specially interesting features will be described in detail.

Case 1. This tumor was removed surgically by Dr. George D. Stewart from whose records I



Fig. 4. Tumor nodule growing from aberrant adrenal cortical tissue at the upper pole of the kidney (Case 2, Group 1). Shows normal adrenal cortex above and tumor nodule below and to the left (low power).

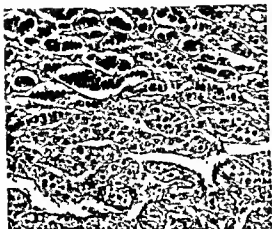


Fig. 5. High power of Fig. 4 showing gradual transition from normal adrenal columns above into tumor cords below.



Fig. 6. An area in the same tumor (Case 2, Group 2) showing a secondary phase, namely fatty changes in the cords and central necrosis of the tumor cords with the formation of pseudo tubular structures.

select the following data. The patient was a white female aged 28 years and single. She was 6 feet in height and of excellently developed musculature. The hair on the head was thick and coarse. On the face, chest, arms and legs there was a thick growth of coarse black hair, that on the upper lip amounting to a small moustache. The mammae were under developed and the chest as a whole was decidedly of the male type. Menstruation was regular. The patient had had a weak stomach since childhood with frequent attacks of indigestion accompanied by violent headaches. No urinary findings or symptoms referable to the kidneys are mentioned. The patient was under treatment for indigestion when a movable mass in the false pelvis was discovered and was thought to be a floating kidney for the rectification of which an operation was undertaken. At the operation the mass in the false pelvis was found to be an encapsulated tumor firmly attached to and apparently growing out from the interior and inner surfaces of the lower pole of the left kidney. The mass was considerably larger than the kidney and so intimately united with it that it could not be separated from it without tearing the kidney parenchyma. The two were apparently enclosed in the same capsule. Both kidney and tumor were removed. About six weeks after the operation the patient died and according to the autopsy findings the cause of death was chronic myocardial degeneration with terminal septic peritonitis. No indication of extension or metastases of the growth was found. The right kidney was about double the normal size. The right adrenal gland was normal. The left adrenal was not found and it was supposed that it had been removed with the kidney at the time of the operation.

I have been unable to find the gross specimen in this case and can procure no description of its macro-

scopic features other than the few details given above. The histological appearance is very similar to that of the adrenal hypernephroma described by Bullock and Sequira (5). The structure is uniform



Fig. 7. Low power showing primary structure of adenoma of kidney developing from convoluted tubules. (Case 1, Group 2.)



Fig. 6 High power of fig. 6 showing well-defined tubular structure

throughout the whole mass and is of an adenomatous rather than carcinomatous type. With the low power, the picture presented is that of solid cordons of polygonal epithelial cells separated by capillaries. These cordons have no basement membrane, but rest directly on the capillary walls from which they are sometimes separated *en masse*, presenting an appearance frequently seen in the columns of the adrenal cortex. In places the cordons are long, narrow and parallel, resembling very much the zona fasciculata of the normal adrenal. In other places they are of varying length and width and somewhat tortuous. There are no papillary, cystic,



Fig. 9 Same case as in Figures 6 and 7, showing a secondary phase, namely, fatty changes in the tumor cells

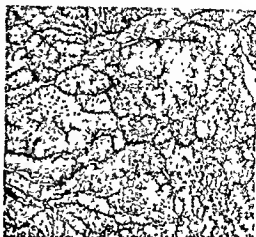


Fig. 10 The same case as in fig. 9 showing further degenerative changes which give the cells a characteristic "glassy" appearance—the "glassy" cells of Steink

or tubular formations. Sections from areas at the junction of tumor and kidney show tumor immediately bounded by a fibrous band in which are here and there compressed and atrophying renal tubules and glomeruli. The tumor at this point shows no capsule. With high powers the size, shape and arrangement of the cells are best described by noting their similarity to the cells of the normal adrenal cortex. The cell membrane is non refractive and frequently poorly defined. The cytoplasm is finely granular and stains moderately pink with eosin. It does not present the "glassy" or "reticulated" appearance so characteristic of the cells in "hypernephroma" of the kidney. Frequently, however, the granules are absent in places giving the cytoplasm a somewhat "foamy" appearance. The nuclei are round or oval and moderately chromatic. Here and there are hyperchromatic nuclei and occasionally a very large one. Not infrequently the cells have two or even three nuclei or a multilobed nucleus. Mitotic figures are present in moderate numbers. As the specimens had been treated with alcohol, fat stains were not attempted.

In this case there is clinical as well as morphological evidence that the tumor is a neoplasm of adrenal cortical tissue. According to the summary made by Glynn (6) from an exhaustive review and study of tumors of the adrenal cortex, "adrenal hypernephromata are associated with sex abnormalities almost invariably in children, usually in adult females before the menopause, but apparently never in adult females after the menopause, or in adult males," the abnor-



Fig. 11. Another area in the same tumor (Case 1 Group 1) showing malignant changes, namely a mixture of carcinoma with giant cell formation and small spindle cell sarcoma.



Fig. 12. Low power showing primary structure of a papillary adenoma of the kidney (Case 2 Group 2). In the lower third of the picture to the right are seen three tubules in cross section which bear a striking resemblance to collecting tubules. Note, also, the fat-laden tumor cells in the capillaries at the top.

malities being 'the diminution of certain female and the development of certain male characters. In this case we have the general male build, great muscular strength and hirsutes together with non-development of the mammae. Morphologically the evidence for the adrenal origin of the tumor is even more convincing. There is not one feature which could suggest a renal origin. The histological resemblance to the adrenal cortex and its primary tumors on the other hand

is almost perfect. There is only one circumstance which precludes the positive conclusion that the tumor originated from an accessory adrenal in the capsule of the kidney, viz. the failure to find the adrenal on the left side. This leaves a possible alternative that we may be dealing with a hypernephroma of a misplaced adrenal gland.

(Case 2. The patient was a white adult male, aged 34 years. There were no features indicative



Fig. 13. Low power of a cystadenoma of the kidney (Case 1 Group 2). Note the swollen glassy appearance of the epithelial cells within the cysts. The dark gray homogeneous areas represent so-called "colloid" the thick areas blood. The epithelial cells are infiltrating the cyst walls in several places.

of sex abnormalities. His earliest symptoms were hematuria and painful urination which persisted for one month and then subsided permanently. Three months later he entered Bellevue Hospital complaining of great general weakness and swelling of the right leg. Later on the left lower extremity became edematous and cyanotic. Pulmonary symptoms developed and in four weeks the patient died. The autopsy was performed by Dr Douglas Symmers who gives the following epitome of the protocol:

The body was that of a man, 53 years of age, 170 cm in length, of large well developed frame, fairly good musculature and nutrition. Both thighs and legs were swollen and pitted deeply on pressure. The body was eviscerated from tongue to prostate. Thyroid. The right lobe of the thyroid was enlarged measuring 7.5 x 4.5 cm. On section this lobe was found to be almost completely converted into grayish tumor material of moderately soft consistence. The left lobe was not affected. Lungs. Both the visceral and parietal pleurae were richly strewed with large and small oval or rounded cream colored or faintly pinkish

tumor nodules. The diaphragmatic pleura just above the spleen presented an enormous conglomerate of tumor nodules. On section of the left lung there was a huge mass of grayish finely granular tumor tissue lying in the lower lobe near the base. Smaller masses were found scattered irregularly throughout the rest of the organ. Large and small nodules of similar appearance were embedded in the right lung. Liver. The liver was considerably enlarged and on section, numbers of tumor nodules were found scattered through the substance of the organ. Kidneys. The right kidney was greatly enlarged, forming a nodular mass 15 cm in length and 10 cm in breadth. On section the organ was found to be extensively replaced by grayish or cream colored nodules moderately soft in consistence and, in places, hemorrhagic or necrotic. Some of the nodules were separated by glistening bands of connective tissue, others were fused. Tumor tissue extended directly into the pelvis of the kidney and into the right renal vein where it was attached to the intima of the vessel and formed a partially occluding thrombus. The right internal iliac vein was similarly occluded by infiltrating new growth. An enormous tumor mass was present in the retroperitoneal tissues corresponding to the point of junction between the iliac and inferior vena cava and nodular extensions from this growth penetrated the walls of the inferior vena cava showing beneath the serous lining as pale, perfectly smooth elevations. The vena cava was opened and found to be greatly distended in that portion lying just back of the liver. The distention was due largely to the presence in the lumen of a cream colored thrombus of tumor tissue which extended directly up the vessel wall stopping just short of the right auricle of the heart. In the opposite direction the neoplastic thrombus was directly continuous with the thrombus described in the renal vein. Both suprarenal capsules were dissected out and were found to be in a state of excellent preservation. The remaining organs presented nothing worthy of comment at this time.

Anatomical diagnosis. Primary hypernephroma of right kidney. Neoplastic thrombosis of the right renal vein extending into the vena cava as far as the right auricle of the heart. Metastatic hypernephroma of pleura, lungs, liver, thyroid and retroperitoneal tissues, edema of lower extremities following occluding neoplastic thrombosis of the iliac vein and inferior vena cava.

Histologically the most interesting feature in this case is the finding of three separate pieces of adrenal cortex in the tumor mass, one measuring about 3.2 x 2.2 cm at the upper pole of the kidney, a somewhat larger one midway between the upper pole and hilus on the inner surface, and a third at the lower pole and continuous with a lobulated tumor mass which bulges from the whole posterior surface of the kidney. The upper two of these bodies show in places the three cortical layers with especially large zona reticularis which contain numerous

deeply pigmented cells. None of the tissue was treated with chrome salts and consequently the presence of chromaffin cells cannot be excluded with certainty, but apparently none is present. In the uppermost body, however, there are blood-vessels in the neighborhood of which are numerous ganglionic cells and nerve trunks. In the body at the lower pole of the kidney different cortical layers are not distinct but the whole outer surface of the body is made up of columns of unmistakable adrenal cells, many of them pigmented, which imperceptibly merge into the structure that constitutes the main tumor mass. The uppermost body is partially split into two parts by a fibrous band in such a way that one portion lies above the kidney and the other dips down into it becoming continuous with the main tumor growth. In the upper part are several adenomatous nodules such as are commonly seen in the adrenal gland, and a few of these have become metamorphosed into the structure that may be called the "primary" phase of the tumor growth. These nodules have no fibrous capsule and show no inflammatory reaction at their border. Their histological appearance is so similar to that of the neoplasm in Case I that a reference to that will serve for its general description. The tumor columns are directly continuous with the surrounding columns of the accessory adrenal and it is impossible to say just where the tumor commences. The adrenal columns as they merge into tumor cordons become tortuous and the intervening capillaries dilate. The tortuosity and capillary dilatation increase as the center is approached and the columns become broader. With the high power the changes noted are increase in the number of the cells, pyknosis of the nuclei, swelling and vacuolization of the cytoplasm with a sharper definition of the cell outline. Stained with Sudan III the vacuolization is seen to be partly due to the presence of fat. In one of the nodules the cells of the central cordons, instead of showing vacuolization of the cytoplasm, have undergone a carcinomatous change, the cytoplasm being scanty, the nuclei hyperchromatic and in some cases multiple.

An exaggeration of the changes above noted in the central portions of these nodules marks the beginning of the "secondary" phases of growth which constitute some of the most striking histological features of the tumor. The most widespread of these changes is the swelling with fatty infiltration of the cytoplasm giving the cells the "hypernephroid" appearance so commonly seen in renal hypernephroma. Occasionally small areas are seen in which the cell outlines are very sharply defined and refractive, while the cytoplasm is utterly devoid of granules or vacuoles, the cell as a whole having that "glassy" appearance which Stoerk claims is a change found only in renal and never in adrenal cells stained with Sudan III. These "glassy" cells sometimes show a large amount of fat and sometimes none, in which latter case the appearance may be due to hydrops, as Stoerk claims. Further changes, apparently closely connected

with these degenerative phenomena, are hemorrhage and necrosis, of which the earliest manifestation is in the central portion of the cordons and especially in those that have grown very large. As a result of these changes a pseudo tubular structure is developed, so called "blood tubules" in case of the former, and sometimes empty tubules in case of the latter. Sometimes among the blood-tubules are seen tubules containing a substance staining pinkish with eosin which might be mistaken for a "colloid" secretion. On close inspection it is quite evident that this substance is laked blood. This tubular formation is clearly an artefact. The lining epithelial cells have no cuticular membrane and lack the regularity of disposition belonging to true tubules, while comparison with earlier stages of the change in neighboring cordons leaves no doubt as to its true nature. Occasionally in these pseudo-tubules there is an appearance of a papillary invagination of the wall, but this too, is plainly an artefact due to the plane of section and is made possible by the peculiar tortuosity and sudden bending of the cordons. Another secondary phase of quite different nature is constituted by the malignant changes. These are especially common in the metastatic nodules in the lungs but occur anywhere. Indication of malignant changes in individual cells may occur early, as was seen in one of the nodules in the accessory adrenal. Later phases are constituted by loss of columnar structure and irregular arrangement of the cells. Syncytial giant cells are common. Some of these areas can be justly interpreted as carcinomatous and others as sarcomatous.

In so far as morphological evidence can go this tumor bears every mark of being a neoplasm of multiple adrenal cortical bodies located in or about the capsule of the kidney. The exclusively cortical character and the location of these bodies, coupled with the fact that the adrenal gland on the same side was found intact, prove conclusively that they were "accessory adrenals."

GROUP II—TUMORS OF RENAL ORIGIN

Before describing a few cases in this group, it may be well to say a word about the nature of the evidence on which the classification is based. The morphological evidence adduced by the advocates of the "renal origin" hypothesis rests on the presence in the tumor of true tubules, cystic, or papillary formations, the tubule being the *sine qua non* of the latter two. The advocates for the "adrenal rest" origin, on the other hand, object that these structures are quite possible developments from adrenal tissue inasmuch as tubules have been found both in the adrenal gland and in its tumors. The evidence in support of this objection, however, is of a most flimsy character. For the presence of tubules in the nor-

mal adrenal the only evidence I have been able to find is the statement of Marchand (7) that "lumina" are present in the adrenals of horses. Other writers on the adrenal either positively deny the presence of tubules or do not allude to the question. Thus Stoerk concludes from his investigations upon the adrenal cortex of man, the cat, the dog, and the rabbit that true lumen formation is absent in physiological and pathological conditions, viz. hypertrophy and adenoma (8). Zehbe in 150 human adrenals found no indication of tubules. The standard authorities on embryology and histology, including Poll, who has worked extensively on the development of the adrenal in vertebrates, make no mention of tubule formation. In the case of tumors of the adrenal, Manasse (9), Askanazy (10) and Kelly (11), each describe a case in which there was lumen formation. The adrenal origin of the latter two cases, however is doubtful as there was tumor growth in the kidney and other organs. Dohbertin (12) described a case in which there was lumen formation and papillary structure. He gives no illustrations but intimates that the lumina were irregular in formation and filled with necrotic debris, a circumstance which arouses the suspicion that both they and the papillary structures were artefacts produced by necrosis. Ribbert (13), Winkler (14), Marchetti, and others have observed these pseudo-tubular and papillary formations, giving them their true interpretation, and we have already described them in Case 2 of Group I.

It seems evident from the above facts that the presence of true tubular structures in a primary neoplasm of the kidney ought to be regarded as strong evidence that the neoplasm is autochthonous. If, moreover, instead of occurring at random, or accidentally, as it were, they are found to follow in their development certain special types of structure which have for their prototypes changes which are not uncommon and indubitably autochthonous in the kidney, the evidence is convincing.

In regard to the histological structure of the tumors in Group II, it may be said generally of all, first, that they contain sufficient extent of "hypernephroid" areas to have

justified the diagnosis of "hypernephroma"; and, second, that they show a sufficiently clear picture of true tubule formation to justify their classification as tumors of renal origin. In many the primary structure of the growth is more or less obscured by secondary degeneration or by malignant changes, but in several it is well preserved, and in each of these latter cases the tubule formation, or what is fundamentally tubule formation, follows in its development some special type of histological structure.

The different structural types followed in these well marked cases may be classified as follows:

- I. Adenoma
- II. Papillary adenoma
- III. Cystadenoma
- IV. Papillary cystadenoma

In Type I the structure consists of tubules separated by capillaries. Though short invaginations of the tubule walls are not infrequently seen, the characteristic tendency of growth in this type is not "papillary" formation but the piling up of the lining epithelium, as a result of which the tubules are transformed into solid cordons. The distinguishing feature of Type II is found in the dilation of the tubules accompanied by long, clean cut, papillary invaginations of the tubule walls. A characteristic secondary change is the proliferation of the epithelium on the papillary ingrowths, which ultimately fills the tubules. In Type III the unit of structure is a cavity lined internally by epithelium and externally by fibrous tissue. The epithelium grows inward in solid masses or in the form of tubules, some of which are distended with a homogeneous substance which stains like colloid. Occasionally the whole cyst is filled with this substance. If there are papillary formations they are evidently artefacts or of the type seen in Type I. In Type IV the structure is the same as in Type III except that the epithelium grows inward in tree like formations on stout branching fibrous stems. In both Types III and IV the epithelial growth tends to fill up the cyst cavities and by eversion to infiltrate the cyst walls, in both cases forming cordons of cells separated by capillaries.

These types may be fundamentally one and their differentiation may mean nothing. They are recorded here simply as a matter of fact. It may be said, however, that each of the tumors in which the primary structure is well preserved follows one of these types to the exclusion of the others, both in the primary growth and in the extensions or metastases, a fact which lends some weight to the suspicion that the types are inherently different or at least associated with different conditions. It might be mentioned, too, that the cystic types are always closely associated with chronic inflammatory changes which exist not merely at the advancing edge of the growth, but throughout the whole mass—a fact which suggests a possible association with chronic interstitial nephritis. Inflammatory changes are found in Types I and II also, but apparently only at the advancing margin of the growth. In regard to age, the cystic types all occurred in patients of advanced age. In the youngest three patients in Group II (42, 44, 50) the tumors were of Type I. But the facts available are too meager for further discussion of these details. The essential points to be noted are, first, that these four types do occur as the primary structures from which a number of so called hypernephromata have developed, and, second, that they are, according to our claims, identical with those varieties of neoplastic and regenerative change which are frequently observed in the kidney in circumstances which exclude all doubt as to their renal origin, the best support of which claim will be found in a brief description with illustrations of one tumor of each type.

CASE 1. This tumor occurred in a woman aged 30, who gave no history of symptoms. The tumor was discovered accidentally and removed surgically by Dr. George D. Stewart. An apparently complete recovery was made but at present, one year later, there is a recurrence of the tumor growth in the abdominal scar. The tumor consists of a mass, measuring 22 x 10 x 15 cm. and completely replacing the kidney. It is covered by a thick, fibrous capsule to which is adherent a large amount of fat, and which strips easily except in a few places where it is infiltrated by outgrowths from the tumor. The stripped surface is grayish in color, coarsely granular, like the surface of a "granular kidney,"

and marked off into six large bulging lobes of about equal size which are separated by deep fissures. Here and there projecting from the surface of the large lobes are moderately elevated sessile nodules varying from the size of a pea to that of a walnut. There are also one or two bunches of agglutinated small lobules of different sizes. Many of the large lobes on palpation are semisubcutaneous. On section the central portion of these lobes is found filled with a gelatinous semisolid substance. The cavities containing this substance are lined by ragged necrotic tissue. Scattered throughout the whole cut surface there is a moderate number of alternating dark reddish, whitish, and yellowish areas.

The histological appearance is most variegated. Sections taken from the granular nodules on the surface of the large lobes, which probably represent the most recently formed parts of the tumor, show a remarkable picture of tubule formation, which is an almost perfect reproduction of the convoluted tubules of the renal cortex. The tubules show no indication of necrosis or hemorrhage which might arouse the suspicion that they are artefacts. On the contrary, they are well preserved and show every mark of true tubules. The cells lining them rest on a basement membrane and frequently their inner surface shows a cuticular membrane. Occasionally there is only one layer of cells lining a tubule and the nuclei are placed in an even row at the base, but as a rule the cells are abnormally increased and the nuclei more or less irregularly situated. In some cases the epithelium is heaped up so as to fill the lumen, thus transforming the tubules into solid columns. Under the pressure of the increased epithelial growth these columns tend to expand and to become tortuous. Here and there the walls are invaginated and give the appearance of "papillary" ingrowths, but on close inspection it is seen that the appearance is due to section on a plane where the tubule or column is twisted or bent upon itself. The cytoplasm of the cells is markedly granular and contains no fat. The nuclei are large, round, and moderately chromatic. The cell as a whole, in general appearance and staining characteristics, is indistinguishable from those of the renal convoluted tubules (Figs. 7 and 8).

Sections from the yellow areas show solid columns of cells following the same general arrangement as above described with only here and there a discernible tubule. The cell cytoplasm is almost devoid of granules, those that are present being very fine and arranged in the form of a delicate reticulum, the meshes of which are filled with fat. The nuclei are small, pyknotic, and irregular in shape and situation. The cell outline is distinguishable, but is dull and non refractive (Fig. 9).

Sections from certain non granular areas of rather indefinite color show a general picture similar to that of the yellow areas, but the cells present a distinctly "glassy" appearance. The cell outline is sharply defined and highly refractive. The cell body is apparently empty, or rather it is bulging,

with some substance that takes neither the ordinary nor fat stains (Fig 10)

Sections from the dark red areas show hemorrhage and numerous so-called "blood tubules" so commonly seen in hypernephroma

Sections from other areas having no special macroscopic mark of description, show sometimes carcinoma of a large-cell type with large hyperchromatic nuclei and the formation of multinucleated and syncytial giant cells, and sometimes round-cell, giant-cell, or small spindle cell sarcoma (Fig 11)

This tumor undoubtedly started as a simple adenoma of the convoluted tubules. Later on as a result of exuberant growth of the epithelium together with supervening degenerative and malignant changes, it presents all the different appearances that have ever been observed in so-called hypernephroma of the kidney

CASE 2 The clinical history of this case was not available. The right kidney is completely replaced by a tumor mass about the size of a grapefruit. The mass is spherical in shape and presents an even, smooth surface. On section the knife becomes covered with grease. The cut surface shows numerous medium sized, encapsulated areas the majority of which are yellowish in color and soft and greasy in consistence. Others are dark red and several are necrotic. The right adrenal gland is replaced by a mass about the size of a small orange, and on section, presents an appearance similar to that of the kidney mass. The renal and adrenal veins, the vena cava and the right auricle of the heart are almost completely filled with similar tumor growth. There is slight extension of the growth from the vena cava into the adjacent portion of the liver, but there are no metastases anywhere

The histological features of this tumor are very clean cut. There are perfectly formed tubules which are long, tortuous and dilated so as to permit numerous long papillary invaginations of the walls. The epithelium on these ingrowths tends to pile up until ultimately the tubules are turned into solid columns. The cells lining the tubules are of the columnar type with well defined cell membranes and deeply staining nuclei which are placed in even rows near the basement membrane, giving the tubules a striking resemblance to the renal collecting tubules. The nuclei of the cells on the invaginated portions, however, are irregularly placed, being frequently at the top of the cells. The cytoplasm of the cells in all parts of this tumor is filled with fat. Of all the tumors examined this one shows the greatest fat content. In numerous places the papillary growth is so extensive that the tubules give the appearance of the tortuous solid cords of cells, thus presenting the histological picture which is usually diagnosed as "hypernephroma." Sections from the adrenal mass, the vena cava, and right

auricle of the heart, all show a similar picture of perfect tubular and papillary formations. There is no indication of carcinomatous or sarcomatous change anywhere. A dominant feature of this tumor, which is also seen to some extent in Case 1 of this group, is the presence of fat laden tumor cells in the capillaries. Everywhere the capillaries are widely dilated and plugged with these cells.

This tumor is unquestionably a malignant papillary adenoma of the kidney, and if morphological appearances mean anything, it arises from the collecting system of tubules (See Fig 12)

In regard to the presence of fat laden tumor-cells in the capillaries, and especially in view of the fact that the vena cava and right auricle of the heart were stuffed with tumor growth, it is worthy of suggestion that large numbers of these cells must have been present in the peripheral circulation. And when it is called to mind that these tumors as a class show a tendency to travel in the veins it is only natural to believe that the finding of fat-cells in the blood ought to be a valuable means of clinical diagnosis. That this is not so may be due to the fact that fat stains are so seldom used in the examination of blood smears that the presence of such cells escapes detection, inasmuch as with ordinary stains they could easily be mistaken for large mononuclear leucocytes or large lymphocytes

CASE 3 This tumor was removed surgically. The clinical features showed nothing worthy of comment. It is a large mass completely replacing the kidney and measuring 10 x 14 x 23 cm. Its surface shows numerous small lobulations. The cut surface presents a honeycombed appearance, the cysts containing a semisolid, gelatinous looking substance. On close inspection it can be seen that these cavities are true cysts.

The histological features of this tumor illustrate Type III. Throughout the whole mass are found cysts with strong fibrous walls lined internally by cylindrical epithelial cells with well preserved nuclei and perfectly clear, "glassy" looking cytoplasm. The fibrous walls are fairly cellular and infiltrated with a moderate number of round cells. The epithelium extends inward in the form of solid masses separated by capillaries, or in the form of tubules which are frequently distended with a homogeneous substance which stains like the colloid casts in chronic nephritis. The fibrous wall is never invaginated, only the epithelium, basement membrane, and capillary. Some of the cysts show a large amount of "colloid" with only remnants of tubules and epithelial masses scattered here and there. Frequently there are free red blood-cells scattered through the colloid or arranged in masses at its

periphery. Other cysts show blood in masses in the lumen of tubules—so-called “blood-tubules.” In certain areas where the kidney structures are partially preserved are smaller cystic formations which are intimately associated with the remnants of tubules present, the whole presenting an appearance sometimes seen in marked cases of chronic interstitial nephritis. In comparing all the different structures in such an area and its vicinity it is difficult to suppress the conviction that one sees a gradual transition from these simpler structures into those that are undoubtedly neoplastic. Frequently the lining epithelium of the cysts grows outward, infiltrating the cyst wall and finally replacing it, in which process the structure of cell columns separated by capillaries is maintained. In this way a number of cysts become confluent and give the appearance of large areas of cords of glassy epithelial cells, to wit, the picture of “hypernephroma.” There is very little fat in this tumor and this is not in the glassy looking cells but in necrotic debris.

The prototype of the primary structure of this tumor is undoubtedly the cystadenoma not infrequently seen in the renal cortex in association with chronic nephritis. A striking feature is the large amount of “colloid.” It is claimed by Stoerk that this substance is a secretion and consequently evidence of the renal origin of the tumors in which it occurs. Ipsen (15) in his cases found it always associated with hemorrhage and thinks it is a product of changes in the extravasated blood. In this tumor it is mostly always associated with hemorrhage and degenerative changes in the epithelium, but occasionally it is present in cysts which are absolutely free from any trace of blood. Another feature of note is the comparative absence of fat in the “hypernephroid” cells. This circumstance also would be regarded by Stoerk and his followers as evidence of renal rather than adrenal origin, though according to the findings in Case 2 in Group I of our tumors it ought to be held of doubtful value.

CASE 4. This case differs so little from the cases in Type III that a very brief description will suffice. The kidney is completely replaced by a large spherical shaped mass about the size of a large grapefruit. The distinctive feature of this tumor is the presence of papillary formations and this can be determined in the gross. The cut surface presents a finely villous appearance. The tissue is very friable and large portions of it are necrotic. If sections of it are placed in water the papillary formations are floated out and can be recognized. The adrenal gland and

peritoneal surfaces on the same side are infiltrated with small nodules of the growth.

Histologically, the picture is that of a papillary cystadenoma, the distinguishing feature being the papillary tree like ingrowths from the cyst walls. The same type of structure is followed in the metastases. The epithelium on the ingrowths piles up, filling the cyst cavity, and also grows outward, replacing the cyst walls as in Case 3. In the solid masses thus produced the cells are swollen and infiltrated with fat, the whole presenting an appearance on which the diagnosis of hypernephroma was based.

The structure of this tumor differs from that of Case 3 in two respects first by the presence of papillary ingrowths on stout fibrous stems, and second by the absence of “colloid” in the cysts. These differences may be only accidental but it is a notable fact that the same differences divide the cystic formations which occur in the kidney in association with inflammatory conditions.

In regard to the frequency of occurrence of each of the four types, of the well preserved tumors 9 follow Type I, and 2 each of the others. The majority, if not all, of the remaining tumors probably belong to Type I.

CONCLUSIONS

1. Of 34 so called hypernephromata of the kidney, there is convincing evidence, from both the clinical and morphological viewpoint, that one of the number was a neoplasm originating in an accessory nest of cortical adrenal cells, although the possibility of origin from the cortical cells of a misplaced adrenal composite cannot, of course, be denied. It is interesting to note that the patient in whom this tumor was found, was a female with pronounced male characteristics.

In still another case of so-called hypernephroma of the kidney, the morphological evidence tends strongly to support the view that the tumor arose from multiple nests of adrenal cortical cells lying in or around the capsule of the kidney. In the remaining 32 instances of so-called renal hypernephromata, however, the morphological evidence indicates that the tumors were derived from renal adenomata. In other words, it would appear from this that the majority of cases of hypernephromata is misnamed and should be classified as nephromata, the term hypernephroma being reserved for malignant tumors arising from cortical adrenal cells.

2 It has been shown (a) that the primary structures of tumors of adrenal origin are essentially different from the primary structures of tumors of renal origin; (b) that the primary structures of adrenal tumors never imitate the primary structures of renal tumors, (c) but the primary structures of some renal tumors (adenomata) can, at an early stage, through proliferative changes, imitate the primary structures of tumors of renal origin; (d) both tumors of adrenal and of renal origin can undergo secondary degenerative and malignant changes, which make their histological features very similar, these changes being practically always present in the renal tumors. On the other hand, they occurred in only one of the two cases of adrenal growths above described. Consequently I believe that the diagnosis of hypernephroma should not be based on the strength of the appearances presented by those parts of the tumor in which secondary degenerative and malignant changes have occurred.

I wish to acknowledge my gratitude to Drs Douglas Symmers, Charles Norris, George D. Stewart, and Guy H. Wallace for their co-operation throughout the course of this work.

REFERENCES

- 1 WILSON and WILLIS *J Med Research*, 1911, xix, n 3, 73; *Davis Arch Int Med*, 1911, viii 60
- 2 GRAWITZ *Virchow's Arch f path Anat*, etc., Berl, 1883, xxii, 30
- 3 SUDOCK *Ibid*, 1893, cxxviii, 405
- 4 ZENKE *Ibid*, 1910, cci, 150; Stoerk, *Ziegler's Beitr*, z path Anat u z allg Path, 1908, xliii 303
- 5 BULLOCK and SEQUEIRA *Tr Path Soc*, Lond, 1905, li, 11
- 6 GUNN *Quart J Med*, 1911, v, 157
- 7 MASCHAND *Festschr f Virchow*, 569
- 8 STOECK *Berl klin Wchschr*, 1908, xvi, 773
Quoted from Glynn
- 9 VANISSE *Virchow's Arch path Anat*, etc, Berl, 1896, cxlv, 313 (Case 25)
- 10 ASKALEV *Ziegler's Beitr z path Anat u z allg Path*, 1893, xiv, 33
- 11 KELLY *Ibid*, 1893, xxii, 280
- 12 DOBBERTIN *Ibid*, 1900, xlv, 62
- 13 RIBBERT *Geschwulstlehre*, 1904, 426
- 14 WINKLER *Die Gewebe der Nebennieren* 1909
- 15 ISEN *Ziegler's Beitr z path Anat u z allg Path* 1912, liv, 233

A CONTRIBUTION TO THE STUDY OF "TWILIGHT SLEEP"

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CORRECT judgment in medicine is formed by expressing the intrinsic values from a vast number of individual observations. This must serve as my only excuse for contributing so small a quota as 100 cases of "twilight sleep" to a happily ever-increasing literature. Our experience with morphine scopolamine analgesia in labor has given us a very favorable opinion of its value, and we hope the citation of our cases and their analysis will encourage a wider trial and a deeper study of this lethean method of delivery. To consider the question fairly we must free our minds from the visions aroused by over enthusiastic advocates of "twilight sleep" as well as from the prejudice excited by its popular exploitation.

These deliveries are not entirely painless and cannot be, for the method is not to be initiated until the woman has had enough

pain and had it so long and regularly as to demonstrate that she is certainly in labor. The prospective mother must be informed of this so that she will not look for a confinement such as the lay press has inclined her to expect—a labor wherein she lies down to pleasant dreams and awakens refreshed, only to find her newborn child at her side. Besides the pain which begins the labor, she must expect to have certain periods during the delivery where pain will be present. These so-called "islands" of pain last from fifteen minutes to half an hour and represent the partial return to consciousness of a woman who is carrying just the required amount of narcotic and no more.

Our technique at Wesley Memorial Hospital follows in the main the rules laid down at Freiburg. We must note, however, a few exceptions. Our delivery rooms are not

padded nor are they impenetrable to street sounds although silence on the part of the attendants is faithfully observed. The subdued light and the absence of relatives we regard as very important, especially the latter for it is a simple thing for an observing friend to fill out the lacunæ between the islands of memory with a description so graphic that the patient is soon convinced that she felt everything as usual. It has happened occasionally that the husband is instructed to hold the patient's hand and watch minutely what takes place so that he may inform his wife later. He agrees to do this, unconscious of the fact that he thereby jeopardizes the success of the treatment.

Our preparation of scopolamine was deliberately chosen from domestic products with the idea of having a drug that would always be available. We used tablets almost exclusively.

We have not employed the memory test rigorously in all our cases since by practice we think we can recognize, in a measure, the degree of drug control by such physical signs as somnolence, flush, mental confusion and the reaction to uterine pain.

In this series of 100 consecutive cases the dosage has been limited meticulously. In no case was the morphine given but once and the scopolamine was repeated only as the symptoms in each case seemed to require. Every patient has received the most careful supervision both of person and of environment throughout the labor. The advance of the presenting part, the frequency and duration of the contractions, and the maternal heart sounds and those of the child are observed as frequently as it can be done without disturbance. Individualization is the secret of success.

Our observations give the following results. Primiparæ 44, multiparæ 56. The longest labors were 29 hours, 25 hours, 23 hours, respectively. The shortest labor was 55 minutes. The average of all cases was 8 hours 37 minutes. In 63 cases, labor was inaugurated with a Voorhees bag. The three stages of labor averaged 4x and one-half hours, one and three quarter hours, and 22 minutes.

As an important factor in shortening labor we may mention that as soon as dilatation is complete and the presenting part well engaged the patient is aroused with the onset of each contraction and urged to bear down. This can be done in most cases without making a "memory island."

Dosage. Morphine sulphate $\frac{1}{8}$ to $\frac{1}{4}$ and scopolamine hydrobromidum $\frac{1}{150}$ to $\frac{1}{300}$ grains were injected under the skin when the contractions were five minutes apart or less.

After an interval varying from fifteen minutes to four hours with an average of one and one-quarter hours the scopolamine was repeated in doses of $\frac{1}{150}$, $\frac{1}{200}$, or $\frac{1}{300}$ grs. The next interval also varied from one-half hour to four hours with an average of one and one-half hours when the scopolamine was repeated as before in a dose appropriately determined by physical signs or memory test. A third dose might or might not be required. In our cases we gave scopolamine twice in 59 cases; thrice in 12 cases, four times in 4 cases, five times in 1 case, in 22 cases only the single initial dose of morphine and scopolamine combined, was administered.

After beginning the injections the following results were obtained as regards pain.

Fourteen felt a few pains, one said she suffered almost as much as when she had her menstrual flow. In 15 pain was greatly diminished but not entirely abolished. In 56 there was no pain whatever. In two cases no relief was admitted. Three women claimed post-partum that they felt every pain just as usual although they showed the mental confusion and the physical signs of drug saturation. One claimed she became fully conscious every time she was aroused to bear down and declared she would have gone through all right if she had been allowed to sleep as ordained in the articles she had read. The injection was given too late to be effective in one case. Four women threw themselves about violently on the bed and showed great mental excitement but afterward reported no pain. In six cases the injections were abandoned on account of weak contractions which threatened a cessation of the labor.

A larger experience will enable us to recog-

nize these cases earlier and either exclude them from "twilight sleep" or possibly give it later when the uterine function has acquired a greater momentum. In a certain proportion of the labors when the head is deeply engaged and the os well dilated, pituitrin can be given with excellent results.

There were two maternal deaths in this series, from placenta prævia complicated with myocarditis and from hæmophilia.

The placenta prævia was centrally implanted but there had been no external hæmorrhage and the diagnosis was not made until the woman went into labor. The hæmorrhage was not great but the shock of delivery was too great for the injured heart muscle and she died two hours after the baby was born. The hæmophilic never formed a clot from the moment the child was delivered, and finally died with the blood trickling through gauze, tightly packed in a firmly contracted uterus. Neither of these cases should have had "twilight sleep."

Eight babies died. Three were macerated and of these, two were twins with hydramnion. The absence of heart-tones and the presence of other symptoms forewarned us of conditions inside the uterus but for that reason it was decided to protect the mothers as far as possible against the pain of an unrewarded confinement. In one case the cord prolapsed. In another the child was born in asphyxia pallida and was resuscitated with difficulty only to die a few hours later. One was premature. Two were delivered with forceps through the moderately contracted pelvis and rigid soft parts of primipara. One was stillborn and the other lived two hours. Both had good heart tones until delivery. Both had but two injections, the first morphine sulphate $\frac{1}{8}$ and scopolamine $\frac{1}{300}$ and scopolamine $\frac{1}{300}$ in one-half hour to two and one half hours respectively.

None of these deaths, in our opinion can be attributed to "twilight sleep."

Three babies were born blue (asphyxia livida) and breathed easily and promptly as usual. Two babies were born in oligopnea and revived thoroughly and permanently in 15 and 20 minutes respectively. Low forceps were applied 23 times and axis traction 2

times. Breech extraction was done three times and version and extraction twice. The perineum was torn to the 2° or less, 23 times.

In about 50 per cent of the cases a few whiffs of chloroform seemed desirable as the head passed the perineum.

We had four cases of violent mental and muscular excitement and these were the only cases in which any restraint was used. All were Jewesses. None of the patients developed insanity. The third stage was not affected, so far as we could see.

The mammary function was uninfluenced unless the absence of exhaustion and the conservation of energy might, as some have stated, result in a more abundant supply of milk. This would be a pure assumption on our part as we have no corroborative observations.

Certain objections have been urged against morphine scopolamine analgesia which in our opinion are unjustified.

First, as to the prolongation of the labor.

It is probably true that the contractions are somewhat retarded by the numbing of the sensory nerves, but this delay rarely exceeds six or seven hours which is far less destructive to the vital powers than the same labor without analgesia even if shorter. To a woman free from pain it is negligible. To the attendant who is supposed to be devoting his time to the case conscientiously and who has arranged for the additional assistants required, the prolongation of the delivery is of no consequence. On the other hand if the obstetrician desires a short labor it is only a matter of technique and training to obtain it wisely and conservatively either with or without "twilight."

The foetal asphyxia and the "blue babies" which are used as arguments by the laity and others equally inexperienced or cunning are no more common with "twilight" than without it. As a matter of fact a blue baby is a natural result of an excess of carbon dioxide in the blood and this excess is the physiological precedent and stimulant to normal respiration. It is only through the accumulation of carbon dioxide in excess that the respiratory centers are driven to functionate with the result that oxygen is taken in.

Difficult control of the patients we found in but 4 per cent of the cases and we feel that this objection can be obviated by a more rigorous discrimination

Post-partum hæmorrhage occurs just as frequently in "twilight sleep" as out of it and no more so

One writer has condemned the method because the signs of the onset of the second stage are unrecognizable except through more frequent internal examination

This may be true with the general practitioner but at the present time the development of "twilight sleep" is or should be in the hands of specialists and anyone worthy of this name should be able to determine the onset of the second stage by external palpation, that is by following the descent of the presenting part with the finger tips

Again it has been urged that the freedom from pain, which opponents of the treatment concede, is unfortunate because the symptoms of antepartum hæmorrhage and uterine rupture may be obscured and the life of the patient endangered. In hospitals where the diagnosis of antepartum hæmorrhage or uterine rupture is made, not upon the declarations of the patient, but upon anatomical findings, this argument of course, is not valid

It has also been stated that the restlessness and violence of the patient predisposes to soiling the genitalia with fecal matter

As we have shown above, mental agitation and muscular excitement are rarely observed except in Oriental peoples and even if it did occur, it would be impossible for the soiling to follow if the colon had been emptied by an adequate and conscientious preparation

Examination of the various arguments against "twilight sleep," as properly administered seems to disclose the prevalence of a feeling that it is better for the woman to suffer than for the objectors to take up the burden of higher responsibility, of assiduous

attention and the more exacting obstetrical skill which these cases demand

It is quite in the course of things that a method of treatment which presents so many opportunities for the intrusion of the personal equation by patient or attendant, or both, will exhibit an astonishing variety of reactions not only during the labor but afterward. Hence the reports will show many diverse results until the elimination of minor differences brings the most important points to standardization

From observation of our cases we believe the morphine-scopolamine analgesia is entirely harmless both to mother and child when properly administered

We believe the treatment has been successful in our hands since we show 29 per cent of our cases were practically, and 56 per cent entirely, free from pain—or 85 per cent in all

We find the strength is conserved and the convalescent period shortened. Whether or not the woman gets up earlier is with us a question of uterine involution rather than one of days or strength or treatment. The main thing is that she feels better much sooner.

It is our opinion that primary pain weakness, hæmorrhage, prolapsed cord, and a lack of correlation between the size of the pelvis and the child make conditions that are unfavorable for "twilight sleep"

We do not believe that "twilight sleep" will succeed in every case, but it does no harm when properly used and we are convinced it will act happily in about 85 per cent of the cases that are selected with due regard to the contra indications

We believe "twilight sleep" to be a valuable and permanent addition to the resources of the obstetrician and that much of the antagonism to it arises from an inability or an unwillingness to bestow upon a woman in labor the unremitting attention and the higher technical proficiency which these cases demand

END-TO-END SUTURE OF THE BILE-DUCTS

By THILODOR F. RIGGS, M.D., F.A.C.S., PIERRE, SOUTH DAKOTA

THE bile ducts present a field for the most interesting and unexpected surgical opportunities. The literature on the subject, especially the writings of Moynihan, Kehr, Fenger, Mayo, and Jacobson, is most instructive but anything like a formal review would be unnecessary and out of place in this paper.

The mechanism of obstruction and occlusion of the bile passages as given by Schuempel (quoted by Fenger), is briefly as follows:

1 Obstruction from within by (a) bodies that fill the lumen; (b) cicatricial strictures following local inflammations of the mucosa; (c) tumors, benign and malignant.

2 Obstruction from without by compression due to masses of scar-tissue or adhesions, the result of chronic inflammation, peritonitis, or perihepatitis.

3 Deviations of the bile ducts caused by peritonitic adhesions between the hilum of the liver and one or more of the neighboring organs.

Destruction of a portion of the bile duct may be the result of trauma, gangrenous inflammation and surgical manipulation, either accidental or intentional.

For the relief of the condition present in any given case one of the following recognized methods of repair or reconstruction would probably be used:

1. Simple suture of the wound.

2. End to end anastomosis.

3. Plastic closure or reconstruction by tissue taken from a neighboring viscus, the transplantation of fascia, blood vessels, or the appendix.

4. Anastomosis of gall bladder or bile-duct with the bowel or stomach.

5. Construction of an entirely new duct by the use of a rubber tube covered by omental tissue.

My experience in unusual bile duct surgery has been limited. In 1906 in Baltimore among seven bile duct operations on dogs three end-to-end sutures of the lower bile-

duct were done with rather unsatisfactory results. Two dogs died on the sixth and one on the seventh day after operation from leakage into the peritoneal cavity. That bile had passed into the bowel in each case was certain and as nearly as we could tell the sutures had held perfectly until the fourth day. In each case autopsy showed only a slight separation of the line of suture and peculiarly this opening was located in each case at the point uppermost in the field of operation where one might expect the most accurate suturing to be done. Had drainage been provided for at the time of operation, the dogs might have recovered, but no drains were used for two reasons: first, that we might test the method, and, second, because in other operations where drainage had been provided we had difficulty in preventing the dogs from pulling out the drains. In man this difficulty is not serious and the value of drainage in all bile duct operations has been impressed upon us by the highest authorities.

Through the courtesy of Dr. A. W. Elting of Albany, New York, I shall now report an unpublished case of choledochoduodenostomy in a part of which it was my good fortune to assist. This case is of interest and value not only in itself but also because the obstructing growth seemed similar macroscopically to the growth in the case I shall report later.

Mr. J. B., aged 53, admitted to St. Peter's Hospital, July 31, 1908. Occupation, contractor. He had not had any serious illness except for an attack of malaria at 11 years of age. This lasted six months and was of the tertian variety. He stated that for the past five years he had bilious attacks occasionally after taking indigestible food, especially cabbage. These bilious attacks were accompanied by nausea, vomiting, and headache. Six weeks prior to admission to the hospital, that is, about June 15, 1908, he first noticed jaundice of his skin and conjunctiva. This jaundice gradually increased and about five days later he noticed that the urine was deeply bile stained and that the stools were clay colored. He was sleepy and had marked itching of the skin. He gradually grew worse and after some three weeks went to Saratoga in the hope of recuperating. While there he grew steadily worse and began to have

fever of an intermittent character with severe irregular chills. The jaundice became very much increased and the general condition very serious, with pronounced toxæmia. At no time had there been any history of severe pain or anything simulating colic. He was seen in Saratoga in consultation by Doctor Elting and was found to be a man fairly well built, although much emaciated, with a very pronounced jaundice. The liver was greatly enlarged and what appeared to be a very markedly distended gall bladder could be palpated below the right costal margin. There was slight abdominal distention. The urine contained a large amount of bile with albumin and casts. The appearance was that of a case of obstructive jaundice with marked cholemia. The patient was operated upon July 31, 1908, at which time a very marked enlargement of the gall-bladder was found. The contents of the gall bladder were of a mucopurulent character. There were no stones. The pancreas appeared to be somewhat uniformly enlarged with no evidence whatever of any pancreatic new growth, the appearance being entirely one of chronic pancreatitis. The gall-bladder was drained. The patient did very well after operation, although practically all of the bile was discharged through the wound. The stools remained clay colored and there was considerable bile in the urine. The patient left the hospital September 5, 1908, but returned on October 16. There had been no diminution in the amount of bile drainage from the wound although the skin and mucous membranes had become practically normal in appearance. The second operation was performed on October 17, 1908, at which time a definite obstruction of the common duct just before it entered the duodenum was demonstrated. The distal inch of the common duct with the papilla was excised and the proximal portion of the common duct implanted into the duodenum. Drainage of the gall bladder was continued. The patient withstood the operation very well. At this time there was some slight enlargement of a few lymphatic glands in the vicinity of the hilum of the liver, but no evidence whatever of any neoplasm. The resected common duct presented macroscopically the appearance of scar tissue. It was carefully examined microscopically at the Bender Laboratory and reported as a benign stricture of the common bile-duct. The patient made a very satisfactory recovery. The sinus closed fairly promptly and the normal course of the bile was re-established. The patient's health improved greatly and he left the hospital on November 20, 1908, in excellent general condition, with his wound firmly healed and his functions apparently normal.

A few weeks subsequent to leaving the hospital, he started for Europe. The voyage was an exceedingly rough one and the patient was very seasick. During this voyage he became somewhat jaundiced and in the latter part of January, 1909, his wound reopened spontaneously and began to discharge large quantities of bile. He returned to the United States and was readmitted to the hospital on

February 18, 1909, at which time he was considerably jaundiced. The stools were again clay colored. There was considerable bile in the urine, some enlargement of the liver, and a profuse discharge of bile through the sinus, which developed in the scar of his previous wound. The patient had lost considerable weight and looked very ill. An irregular mass could be felt in the region of the scar and was believed to be in all probability carcinoma. An exploratory operation was performed and extensive carcinoma of the upper right quadrant of the abdomen was found. This appeared to have originated from the region of the sutured common duct. At this time a re-examination of the portion of common duct excised at the previous operation was made, and after the study of a very considerable number of sections, a few sections were obtained in which minute areas of carcinoma simplex were found. This corresponded to the microscopical type of carcinoma as revealed at the operation done in February, 1909. The patient lived for about a week after the operation and died from exhaustion. An autopsy was not obtained.

The next case is that of a man referred to me by Dr. A. H. Youngs of Pierre on November 5, 1912.

C. B. T., aged 54, occupation, assistant in U. S. Land Office. Family history unimportant. Personal history, no serious illness. Indigestion on eating heavy food noted during past twenty years. Present illness began in 1906, associated with an attack of indigestion and characterized by pain in epigastrium, nausea, constipation and slight jaundice. This was followed by one or two recurrences, similar in character, during the ensuing year but at no time was the patient seriously ill. Slight attacks were again noticed in 1911 with gradually increasing severity and some loss of weight. A peculiar state of mental depression and increased irritability were noticed by the patient's friends.

Examination showed a large, well formed man. His temperature was normal, mucous membrane of good color, moderate jaundice and a trace of bile in the urine, stools rather light but not clay colored. The general examination was negative but there was moderate tenderness over the region of the gall-bladder. The liver was not enlarged.

The patient was admitted to St. Mary's Hospital on November 7, 1912, with a diagnosis of cholecystitis and cholelithiasis. Operation November 9, 1912, after anesthesia. An incision was made over the inner side of the upper right rectus. There were many fine pale adhesions between the gall-bladder and surrounding tissues. The gall-bladder small, gray in color, and containing a few small palpable stones. No stones were felt in the ducts but near the junction of the hepatic and cystic ducts a mass was felt which was thought to be a stone. The field was exposed by packing off the intestines and mobilizing the liver in the manner described by Moynihan, thus bringing the ducts into view. The

cystic and hepatic ducts entered a somewhat encapsulated mass of brownish granular material suggestive of an old abscess and upon clearing this way it was found that the ducts lay parallel for a distance of about 3 cm. The hard substance which had previously felt like a stone was now seen to be grayish white in color, slightly spindle shaped and situated exactly at the juncture of the three ducts, involving all three. There was no appreciable dilatation of the hepatic duct. Aspiration of the gall bladder showed bile-stained mucus. A longitudinal incision of the mass showed an annular constriction almost entirely closing the lumen of the hepatic common duct and evidently also obstructing the cystic duct. Macroscopically the mass was about 1.5 cm. long and nearly as thick and appeared to consist of white fibrous tissue. Malignancy could not be ruled out but the lymphatic glands found were large and soft and seemed to be due to an inflammatory process. Because of the possibility of malignancy and the fact that the gall bladder could not be used in a choledochostomy we resected about 3 cm. of the bile-ducts, including the mass, and did a cholecystectomy, all the tissue being removed in one piece. It was first thought to bridge the gap by a rubber tube passed through the common duct to the bowel but we found it possible to approximate the ends of the severed hepatic and common ducts and accordingly an end-to-end suture was done after the manner devised by Carrel for blood vessel suture, No. 00 chromic catgut being used. The suture line was covered by omental tissue. The hepatic duct was not drained because of possible valve formation from infolding of the edge of the common duct but a rolled rubber-tissue drain was placed near, but not touching, the site of the anastomosis, and after covering in the raw surface of the liver left by the removal of the gall bladder the abdominal incision was closed. The patient withstood the operation well. The bowels were moved freely on the third day, bile showing plainly in the stools. On the third day the patient vomited several times and was troubled by severe hiccough but there was no bile on the dressings. After a very restless night, because of the hiccough, a faint stain of bile was noticed the morning of the fourth day, November 12. The biliary drainage gradually increased in amount for several days and on November 16 the stools were clay colored but soon the bile appeared again in the bowel movements and on December 9, 1912, after having been up since November 26, the patient was discharged. Microscopic examination of the constricting mass showed only scar tissue and the fact that today, three years after the operation, the man is in excellent health would bear out this report. I regret that owing to an accident two years ago which destroyed an entire tray of specimens I am unable to show you this specimen.

In September, 1914, J. H. Jacobson of Toledo, Ohio in an excellent paper entitled

"Repair and Reconstruction of the Bile-Ducts" reported an end-to-end anastomosis of the severed ducts. He carefully reviewed the literature and collected thirty-one additional cases which he classified as follows under the head of "Operative Technique Employed."

End to-end anastomosis with circular suture, with drainage of the hepatic duct	21
End to-end anastomosis with circular suture, without drainage of the hepatic duct	2
New duct formed from loop of small intestine	3
New duct formed by rubber tube	3
Hepaticocholangioduodenostomy	1
Choledochoduodenostomy	1
Plastic closure	5
Not sited	—
	34

In this series there were only two deaths.

In Jacobson's case bile appeared on the dressings on the fifth day and in reality his case and the one here reported were little more than modifications of end to end anastomosis with hepatic drainage.

That in approximately 90 per cent of the cases reported injury to the bile ducts was accidental should serve to emphasize both the frequency of atypical implantation of the cystic duct and the necessity of extreme care in the technique of cholecystectomy. No doubt we have all heard Dr. C. H. Mayo say that "the gall bladder should never be used as a handle," but that one should begin at the cystic duct in doing a cholecystectomy.

It would be interesting to compare the possible advantages of the method of Sullivan, Stone, Walton, Lanphear, or R. H. Jackson over that which was used in this case, but as this is impossible I present the report as it is appreciating fully the words of Dr. George Emerson Brewer relative to certain surgical successes: "When aided by nature, a sound constitution, and a high degree of normal resistance."

REFERENCES

- BREWER, GEORGE EMERSON. Some observations upon the surgery of the biliary passages. *Surg. Gynec. & Obst.* 1912, **xiv**, 433.
 DAVIS CARL B. and LEWIS DEAN. Repair of the common duct by means of transplanted fascia. *Western Surg. Ass.* 1913, **p** 21.

ELTING, ARTHUR W. Choledochoduodenostomy. Personal communication.
 FENGER, CHRISTIAN. Retention from displacement, bending, and valve-formation (oblique insertion) in the biliary tract. Collected works, vol. II, p. 815.
 JACKSON, REGINALD H. Anterior choledochojejunostomy. Surg., Gynec. & Obst., 1914, xix, 232.
 JACOBSON, J. H. Repair and reconstruction of the bile ducts. Am. J. Obst., N. Y., 1914, lxx, No. 6.
 LANPHEAR, EMORY. Two operations for total destruction of the gall ducts. Surg., Gynec. & Obst., 1909, xiii, 406.
 MANN, ARTHUR T. A rubber tube in the reconstruction of an obliterated bile-duct. Surg., Gynec. & Obst., 1914, xviii, 326.
 MAYO, WM. J. and CHAS. H. Complete obstruction of the common duct of the liver, anastomosis between gall

bladder and jejunum by means of Murphy's button. Northwestern Lancet, 1893, June 1.
 MAYO, WM. J. Some observations on cases involving operative loss of continuity of the common bile-duct, with the report of a case of anastomosis between the hepatic duct and the duodenum. Ann. Surg., Phila., 1905, July.
 MOVSHIAN, SIR BERKELEY. Operations for obstruction of the common duct. Abdominal Operations, vol. II, p. 308.
 STONE, I. S. Complete division of the common duct at junction with hepatic and cystic ducts suture. Surg., Gynec. & Obst., 1909, ix, 590.
 SULLIVAN, ARTHUR G. Reconstruction of the bile ducts. J. Am. M. Ass., 1909, lvi, 774.
 WALTON, ALBERT J. Reconstruction of the common bile-duct. Surg., Gynec. & Obst., 1915, xxi, 269.

SIMPLE SUBPARIETAL RUPTURE OF THE KIDNEY

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SUBPARIETAL rupture of the kidney may be divided into complicated and simple, in the former there is additional damage to other viscera, in the latter the kidney is the only organ injured. A classification based upon the extent of the damage to the kidney is of little clinical or practical value. Simple rupture of the kidney, to which we shall confine our remarks, is much more frequent than are the complicated injuries. In 637 collected cases, 512 were simple and 125 complicated. In another series 30 were simple and 9 complicated, in my personal experience of 5 cases 1 was complicated and 4 were simple.

That rupture of the kidney is not common was shown by the fact that in 1910 in a report on "Primary Suture of Subparietal Rupture of the Kidney" (1), I was able in a rather extensive review of the literature to find record of only 841 cases. A review of the literature since that time fails to show a marked increase in the report of cases. Gibson (2), Mayer and Welken (3), Michelson (4), Ponomareff (5), Beall (6), and others have made recent important contributions to the subject.

The kidneys seem to be as well if not better protected from injury than the other abdominal viscera, yet they are frequently injured in case of abdominal contusion. The fact that there are two kidneys, of course

accounts in a large measure for this frequency.

A theory as to the cause that may explain a majority of the cases is that of Kuester, in which the rupture is supposed to be due to hydraulic pressure acting through the full vessels and the pelvis of the kidney which causes the organ to burst along lines radiating from the hilum toward the point of maximum impact against the lower ribs, the opposing resistance being supplied by the vertebral column.

Abdominal contusion most liable to cause damage to viscera is that in which there is a sudden strong impact against the anterior or lateral abdominal wall. This occurs usually when the patient is taken unawares, and the abdominal muscles do not have time to contract in self-defense, such contusions may be inflicted by a fall against a sharp object, or blows from a hoof, a fist, a thrown ball, a carriage pole, or a piece of wood from a circular saw. Indirect injury such as a fall upon feet or buttocks, may cause rupture. Even muscular action alone may be followed by rupture. This usually occurs in a pathologic organ. Wade (7) recently reports a case of spontaneous bilateral rupture in acute parenchymatous nephritis.

Thirty cases of spontaneous rupture have been reported due to arteriosclerosis inter-

stitial, acute parenchymatous nephritis, neoplasm, tuberculosis, abscess, stone, infarcts, polycystic and solitary kidney. Another type of injury, such as being run over by a wheel, or crushed between car-bumpers, more often results in a complicated rupture.

A most important element in the recognition of these cases is attention to the history of the accident and the nature of the traumatism. Shock and collapse are often transitory, or may be absent; lack of recognition of this fact has been the cause of mistaken diagnosis and delay in proper treatment in a great many cases. Pain is usually severe at the time of the injury. It may be diffused, or localized in the kidney region. Its duration varies greatly, but it is usually present and is followed by tenderness and dull ache in the region of the ruptured organ. Rigidity of the muscles, with tenderness on palpation in the kidney region, is practically constant, and is of great importance.

Hæmaturia is generally present, it may be delayed in onset, or may occur with the first urination. It may be absent, in case the ureter is blocked with blood-clot, in case there is a transverse tear of the pelvis or ureter, or in case of complete pulpification of the organ. It must be remembered that hæmaturia following trauma may be due to injury to the urethra, bladder, or ureter, and when originating in the kidney may be due to causes other than rupture of that organ.

Tumor in the loin may be absent, may be present immediately after the injury, or may be a late development.

The diagnosis of a kidney lesion demanding an exploratory incision may generally be based on a history of particular abdominal contusion, with rigidity, tenderness or tumor, and hæmaturia.

Treatment may be expectant or operative. In Watson's series with expectant treatment 27 per cent of the simple ruptures resulted fatally. Radical operative treatment, that is, nephrectomy, resulted in 22.5 per cent mortality in 132 cases of simple rupture (Watson's, 8, and Neilson's, 9, cases). Conservative operative treatment that is, gauze packing, drainage, or suture, gave a mortality of 8.5 per cent in 107 cases. Of the 125 cases

conservatively treated, gauze pack or drainage was employed 115 times, with 16 deaths, suture of the renal wound or wounds, 10 times, with no fatality.

The decision between expectant and operative treatment is a momentous one, as the fate of the patient often rests on this decision. Concerning the former Neilson says: "So-called expectant treatment is permissible only in cases in which the local symptoms are insignificant, constitutional symptoms absent, and slight hæmaturia, alone directs attention to the probability of renal injury."

Yet there are many severely damaged kidneys which if left alone, will cause death or prolonged illness, in which the local symptoms are insignificant, the constitutional symptoms absent, and with but slight hæmaturia.

There may be no differential sign or symptom between slight injury and complete rupture; therefore, it would seem advisable to expose the kidney and arrive at a positive determination as to the extent of the injury in every case in which we can arrive at a diagnosis of injury of the kidney, and not guess at the seriousness or the triviality of the injury. By so doing a certain number of unnecessary exposures of the kidney will probably be made. On the other hand, a certain number of deaths will be prevented, and many prolonged illnesses and unsatisfactory results will be substituted by prompt and satisfactory recovery. As in certain cases it is impossible to separate the slight from the extensive injury it behooves one to treat all cases as though they were serious until they have been proved to be otherwise. That this view is not taken by all is shown from the discussion of my paper at the Western Surgical Association in 1910, from the writings of Ponomareff, Frank, Michelson, and others who advocate the non-operative treatment and advise operation only when necessary to save life and when it is reasonably certain that complete recovery may be obtained in no other way. On the other hand Beall concludes that, except for cases of mild degree, early operation for rupture of the kidney must be considered a life saving measure.

All operations for rupture must be ex-

ploratory at the onset, and may then be either radical or conservative depending upon the conditions found. Nephrectomy has in the past been employed quite extensively, but, from the experiments of Dolgoff (10) and from the clinical evidence of exploratory nephrectomy and the frequent, satisfactory recovery after conservative measures, it would seem that packing, draining, or suture might be more frequently substituted for nephrectomy. Gauze packing or drainage is the most common method of conserving damaged kidneys, having been employed 115 times in 125 cases in which conservation was attempted.

Primary suture has been performed on but few occasions though it is the ideal method of dealing with such injuries. Watson was able to collect reports of 8 cases and Neilson added 2 that were treated in this manner. In my article in 1910 I was able to find 3 additional cases in the literature which with the personal case reported made a total of 14 instances of primary suture of ruptured kidney. In the present contributions to the subject I am able to report 2 additional cases. Thus we have record of 16 cases of primary suture of kidney for rupture, with no death and only two unsatisfactory results. In one (Delbet) a secondary nephrectomy was necessary, and in the other (Watson) a fistula resulted.

In every case the sutures, when placed, caused satisfactory hemostasis. In one of Griffith's cases, that of a man aged 48, the mattress sutures pulled through the very friable organ, and the fibrofatty capsule was sutured, inclosing the kidney as in a bag, with a satisfactory outcome. Dolgoff found that wounds of the kidney healed much more rapidly if the capsule was preserved and especially if its cut edges were united. In one, my own case, the capsule of the upper third of the organ could not be united, yet the result was entirely satisfactory.

In another the fatty capsule was utilized as a hemostatic and answered the purpose admirably.

In Fredet's case the patient had a nephritis and it was for this reason that nephrectomy was not done. As a consequence of the most encouraging result in this case, Fredet in his enthusiasm says "Nephrectomy is indicated

as a late operation only where there is widespread infection."

A brief synopsis of my personal cases is here appended:

CASE 1 M R (Already reported in *Journal of the American Medical Association*, March 25, 1911) A school boy of 11 years fell from his bicycle, striking the lumbar region against the curbing. He was able to walk home, but developed pain, tenderness, rigidity, and hematoma. Operation 36 hours later consisted of suture of stellate tear, recovery.

CASE 2 M A A little girl aged 5 years fell and struck her side against fence. I did not see her until ten days after injury at which time there was a distinct tumor in the kidney region, with a history of hematoma following the injury. There was at this time no blood in the urine. Incision revealed a distended capsule, intact, containing urine and blood. The kidney was ruptured with its upper third, gangrenous, floating in the fluid, entirely free from the remainder of the organ. The ureter was torn, therefore there was no blood in the urine, and consequently nephrectomy was performed, uninterrupted recovery.

CASE 3 A. W. Baseball player aged 24 years, while "sliding home" was struck in the side by catcher's knee, he was nauseated, and had some pain, but played in field for two innings. Then nausea and severe pain, called for the administration of morphine and he was sent to the hospital. The next day he was better and wanted to leave the hospital but in the evening morphine was again necessary, for pain. On the morning of the second day, blood in urine and rigidity in the kidney region led to operation. The incision revealed rupture of the capsule, with hematoma and the kidney torn into three pieces by two transverse tears. These were sewn with chromic catgut, and followed by perfect recovery. At last reports he was again playing professional baseball.

CASE 4 Young man of 30 years, was struck in the back by an automobile, was thrown 20 feet, got up without assistance, drove six miles in buggy, and went without medical attention from midnight until morning. On the afternoon of the next day, blood appeared in the urine and he was brought to the hospital 28 hours after injury. Blood in urine with tumefaction, and rigidity in the kidney region led to incision which revealed a stellate tear of the kidney, which was sutured with catgut; prompt recovery followed.

Of these four cases of rupture of the kidney, 4 patients are living and all the kidneys were saved except the one in which a ten day interval was allowed to elapse between the injury and the operation.

CONCLUSIONS

1 Shock, injury to other organs, and external evidence of trauma, are frequently absent in subparietal rupture of the kidney.

2 History of abdominal contusion followed by tenderness, rigidity, and hæmaturia is sufficient to lead to a diagnosis of injury of the kidney

3. Slight lesions and serious rupture of the kidney may not be differentiated by clinical signs or symptoms

4 Exploratory incision will reveal the nature and extent of the injury.

5 Proof that there is an absence of serious rupture is called for, before instituting the so-called expectant treatment

6 Nephrectomy should be reserved for very extensive injury of the organ or late cases.

7. Conservative treatment, preferably by suture, is indicated in the majority of early cases

BIBLIOGRAPHY

- 1 CONVELL J Am M Ass, 1911, March 25
- 2 GIBSON N Y St J Med, x, No 6
- 3 MAYER and WELKEN J Am M Ass, 1911, October 14
- 4 MICHELSSON Arch f Klin Chir, 1911, xcvi, No 3
- 5 FOMORVREFF Beitr z Klin Chir, 1914, lxxix
- 6 BEALL Med Rec, 1913, lxxvii
- 7 WADE J Med Research, 1915, xx, 410
- 8 WATSON Boston M & S J, 1903, cxlii, 29
- 9 NELSON Am J M Sc., 1908, cxxv, 54
- 10 DOLGOFF N Y. M. J., 1900, lxxii, 871.
- 11 GRIFFITH Brit M J, 1908, April 25, p 970
- 12 FREDET Surg, Gynec, & Obst., 1909, ix, 695

BLEEDING NIPPLES¹

By DEAN LEWIS, A.D., M.D., F.A.C.S., CHICAGO

THE clinical significance of a discharge from the nipple of a nonlactating breast has been variously interpreted. Saar, in an article published in 1907, found that a discharge from the nipple occurred frequently with cystadenomata. It was found in 31 per cent (15 out of 48) of the cases analyzed by him. In some instances it was the first symptom which attracted the patient's attention and for which the surgeon was consulted. The amount of secretion varied, usually coming out in drops, but when pressure was exerted it could often be forced out in a stream. It was watery milky, or serohæmorrhagic, rarely pure blood.

A scanty, thin sanguinolent discharge is usually regarded as suggestive of carcinoma, a mucoid discharge of a benign growth, and a markedly bloody fluid as of an intracanalicular papilloma. Bloodgood states that a discharge from the nipple, except during lactation may be looked upon as a sign of a benign lesion and not as a symptom of cancer. If the discharge is serum or blood, this is a positive sign of an intracanalicular papilloma. In senile parenchymatous hypertrophy one can often express from the nipple a thick brownish material, the accumulation

of degenerated epithelium. This the patient rarely observes. In a personal communication Bloodgood also states that he is inclined to think that many surgeons look upon a discharge of blood from the nipple as a sign of cancer.

The pathological processes associated with the discharge of a hæmorrhagic or serohæmorrhagic discharge from the nipple have many interesting features. The tumor most frequently associated with the discharge is regarded by some (Kaufmann) as rare, but most surgeons having considerable material can recall some few cases of bleeding nipples, most of which have never been reported or carefully analyzed. The pathological changes associated with this symptom have been so variously interpreted and have received such a variety of names—encysted medullary carcinoma, cystofibroma, villous carcinoma, and duct cancers—that it is often impossible to determine whether the lesion under consideration is benign or malignant. By some—Koenig, Saase and Greenough—the intracanalicular papilloma, by all odds the lesion most frequently associated with a discharge from the nipple, is regarded as distinct from abnormal involution, while Saar and



Fig 1 Section of papillary cystadenoma situated in one of the larger ducts near the nipple. The cyst was the size of a hazelnut. When pressed upon this cyst could be reduced in size and a stream of a serohemorrhagic fluid at times of almost pure blood could be forced from the nipple. There had been an intermittent discharge of a serohemorrhagic fluid from the nipple for eight years. A tumor situated superficially just to the inner side of the nipple developed two weeks before the operation was performed. (See Case 4.)

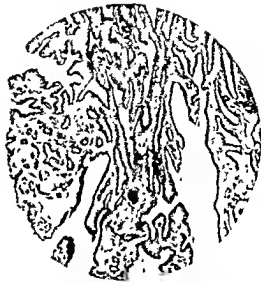


Fig 2 Section of an intracanalicular cystadenoma removed from a breast in which no tumor could be palpated. A serohemorrhagic discharge from the nipple had been noted for eight months. The papilloma, not larger than a small pea, was situated deeply in one of the ducts. It was so small that it could not be palpated. (See Case 6.)

Tietze consider this type of papilloma as intimately associated with or a part of abnormal involution and consider the two together.

I have observed clinically seven cases of bleeding nipples five of which have been operated upon. One case had been operated upon previously and several cysts removed. A discharge from the nipple subsequently developed in this case but no operation has been performed up to the present time. The following histories indicate the course of the disease associated with the discharge and the pathological findings.

CASE 1 Mrs W. aged 42. Married but never pregnant. One sister has had a radical removal of the left breast for carcinoma; lately there has been a recurrence in the scar. Five years ago I operated upon Mrs W. and removed two small cysts from the left breast and one from the right. These cysts the largest of which was the size of a walnut contained a thick milky fluid. When examined histologically the cyst wall which was composed of thick fibrous tissue was found to be lined by a layer of degenerating epithelium which in some places had almost disappeared. Three years after

these cysts were removed a milky discharge from the left nipple was noted. This continued for about one year. One year later a watery secretion was noted from the right nipple. Last January this discharge became serohemorrhagic in character, the amount of blood being increased by manipulation of the breast. During March, April, and June, no discharge was noted and during the past three months there has been none. The milky discharge has gradually grown less in amount, until at the present time there is very little. There has been no distinct tumor or cyst formation associated with the cessation of the discharge.

The diagnosis of senile parenchymatous hypertrophy was made when the cysts were removed, some small cysts being found adjacent to the larger ones. When I examined the patient last Spring a serohemorrhagic discharge from the right nipple was noted, and a somewhat milky discharge from the left. A careful search was made for a tumor beneath the left areola but none could be found. A secretion could be expressed from the nipple when the breast was manipulated, but no definite tumor could be found although the breast had the peculiar shotty feel of microcystic disease. Operation was refused by the patient. Subsequently the discharge stopped, apparently without the filling of a cyst, as might have been expected if a duct containing a papilloma had become occluded. There is no clinical evidence of any malignant change in the breast. An operation is undoubtedly indicated,

but I believe that a plastic resection of the breast rather than removal should be attempted

Case 2 is considered with the preceding because both are apparently examples of abnormal involution associated with a sero-hemorrhagic discharge from the nipples

CASE 2 Mrs A T, aged 37 was admitted to the Presbyterian Hospital February 11, 1915. She has given birth to three children. It was noticed that the clothing covering the nipples was blood-stained in June, 1914. Shortly after this the patient became conscious of an itching sensation about the nipples, but did not know whether there was any relation between this and the bloody discharge. September 7, 1914, she consulted a surgeon who advised that both breasts be removed, a radical operation being advocated. A second physician advised that nothing be done for three months. During September and October the bleeding seemed to be more profuse and was great enough to show through the clothing. During the past few months the discharge has not been very profuse. There has always been more discharge from the left than right nipple. The itching sensation has been more marked about the right nipple. Both breasts are rather large. When palpated they have the shotty feel of microcystic disease. A sero-hemorrhagic discharge can be expressed from the nipples when the breasts are palpated. No single cysts beneath the areolae can be felt.

An operation consisting of a plastic resection was performed upon each breast, through a curved incision made on the median side of the areola. The entire glandular substance of the breast was removed through this incision. The glandular tissue was fairly riddled with small cysts varying in size from a buckshot to a cherry. Some of the cysts had a milky other sero-hemorrhagic contents. No distinct papillary growths could be seen on gross examination. Because of the peculiar granular feel of some of the cysts a careful histological examination was made of tissue removed from different parts of the gland in order to be sure that there were no malignant changes.

Microscopic examination revealed distinct evidences of papillae formation. The epithelium in many of the cysts was grouped to form definite papillary growths supported by a connective tissue stalk. This is a form of the adenocystic type of chronic mastitis. The same process results in the formation of papillomata in the ducts the growths most frequently associated with a sero-hemorrhagic discharge from the nipple.

CASE 3 Mrs A D aged 51. Patient had given birth to one child. Nine months before entering hospital she sustained a slight injury of the right breast. Four months later she noticed a nodule in the breast located superficially, about one inch above the nipple. During the last three months there has been at times a discharge from the

nipple. At first this was serous in character. Later it became tinged with blood. The discharge is intermittent. There may be intervals of ten days or more during which there is no discharge. Then the nodule in the breast enlarges and there is a sensation of fullness. When the discharge is poured out the nodule decreases in size and the sense of fullness is lost. The nodule is tender on pressure. There is no spontaneous pain.

The nodule is the size of a hazelnut. It is situated beneath the areola above the nipple. When this nodule is pressed upon a sero-hemorrhagic discharge can be expressed from the nipple. At the time the patient was examined the discharge consisted almost entirely of pure blood which could be expressed, drop by drop, when the nodule was pressed upon.

A radical operation was performed in this case because of the suspicion of malignancy. When the nodule was incised a distinct intracanalicular papilloma was found. The base of this cyst has a distinctly granular feel and appearance, differing from the intracanalicular papillomata about to be described.

Upon histological examination, it was found that the epithelium had broken through the basement membrane at some points. Malignant degeneration of the papilloma had already occurred but the operation had evidently been performed at a very early stage of the malignant change.

Within a year a large mass developed rather suddenly in the left breast, which was removed at another clinic. There were no microscopic evidences of malignancy in this breast, which represented the cystic type of chronic mastitis. This patient was operated upon in the spring of 1911 for the malignant papilloma and there has been no recurrence of the growth.

CASE 4 Mrs N W, aged 46 was admitted to the hospital April 13, 1914. For eight years she had noticed an intermittent discharge from the left nipple. The discharge had recurred every four or six months. For nine weeks before entering the hospital the discharge had been almost continuous. Two weeks before entrance she noticed a tumor about the size of a hazelnut, situated superficially beneath the areola to the inner side of the nipple. This tumor developed rather quickly. The general examination revealed nothing and the remaining history has no bearing upon the subject under discussion.

A sero-hemorrhagic discharge can be expressed from the left nipple when pressure is made upon the small tumor above mentioned. The tumor could be reduced in size by pressure and the sero-hemorrhagic discharge became more bloody when pressure was made. The tumor was not adherent to any of the surrounding structures and could be easily displaced. The examination of the breast was otherwise negative. No cysts or irregularities could be found in the right breast.

A radical operation was performed. Upon sec-



Fig 3 Section through the acinus of a breast on which a plastic operation was performed. The papillary formation is very marked. The breast presents the typical changes of adenocystic disease. Hemorrhage is associated with papillary growths whether occurring in the acini or ducts (see Case 2). Compare with following section from a breast upon which a plastic operation was performed for abnormal involution in which there was no discharge from the nipple.



Fig 4 Section through an acinus of a breast upon which a plastic operation was performed for abnormal involution. The epithelium lining the greater part of this acinus has disappeared. The remaining epithelium shows marked degeneration. The contents of the distended acinus was milky. There was no discharge from the nipple.

tion of the tumor a typical intracanalicular papilloma was found. There were no evidences of malignancy. A gross examination of the other parts of the breast revealed none of the changes associated with abnormal involution and no other papillomata.

The patient has remained well since the operation and as far as can be learned there have been no changes in the remaining breast.

Figure 1 indicates the histological picture of this typical intracanalicular papilloma. Irregular tortuous openings and spaces are found and there is apparently an attempt to form ducts and acini. Club shaped processes project into some of the larger spaces. These are covered by epithelium supported upon a connective tissue stalk, the ends of which in some instances are rather thick. They are so thick in some instances that the villus like projection might easily break off and thus give rise to bleeding within the duct. The glandular type of epithelial reproduction is not always preserved and in some instances there might be a suspicion of carcinoma for the bases of the villus like ingrowths are in some places so thin that it is difficult to determine the exact limits existing between epithelium and connective tissue.

The two following cases are examples of bleeding nipples in which no tumor could

be palpated, but during the operation a small papilloma was found within a milk duct, deep in breast tissue.

CASE 5 Mrs C F, aged 35. Never pregnant. Was admitted to the Presbyterian Hospital May 12, 1914. She had noticed a discharge from the left nipple for some weeks. At times this was serous in character but often became blood stained. The discharge varied considerably in amount and at times almost entirely ceased. There were no other symptoms. The breast was not perceptibly enlarged and no pain was complained of. Upon palpation no distinct evidences of a tumor could be found and the breast did not have the shotty feel of adenocystic disease. When pressure was made over the upper and outer quadrant of the breast, a serous fluid could be expressed, and the fluid became blood stained if the pressure was continued.

As no definite tumor could be found, the upper and outer quadrant of the breast was resected, as pressure over this quadrant caused the nipple to discharge. As one of the larger ducts was cut across near the nipple a serohemorrhagic discharge was noted and deep down in this duct was found a small papilloma about the size of a small pea. As far as could be determined by gross examination there were no changes in the rest of the tissue removed and there has been no recurrence of the discharge since the operation.

CASE 6 Miss M B, aged 38, was admitted to the Presbyterian Hospital November 16, 1913. She had noticed a discharge from the right nipple for ten months. At times the discharge had been great enough to soil a rather large breast covering in 24 hours. No distinct pain had been noticed

Neither breast was enlarged. No definite tumor could be felt, but the discharge could be increased in amount when pressure was made over the upper and outer quadrant of the right breast. A plastic resection of the breast according to the Warren method was performed. When one of the large ducts was cut across near the nipple a serohæmorrhagic discharge escaped. Situated deeply in this duct was a small intracanalicular papilloma (see Fig. 2) such as that described in Case 5. There were some evidences of beginning microcystic discharge upon gross examination, but the changes were not nearly so marked as would be inferred from the findings revealed by palpation of the breast.

CASE 7. This case has been offered me by Dr. Carl B. Davis, who has had the patient under observation for some time. Mrs. C. F., aged 48, noticed last September some bleeding from the left nipple. The discharge was slight, but was enough to stain the underclothing. The bleeding soon stopped and now there is only an occasional watery discharge. No tumor could be palpated in the breast and there were none of the changes associated with cystic mastitis. The clinical findings in the breast corresponded to those in Cases 6 and 7, and the probabilities are that in this case the lesion is an intracanalicular papilloma which is so small and deeply situated that it cannot be palpated. Owing to the fact that the discharge is only occasionally observed and has become watery, the patient has refused to have any operation performed upon the breast.

These seven cases all presented a typical serohæmorrhagic discharge. The discharge in two of the cases at times became almost pure blood. In two cases the discharge was associated with chronic cystic mastitis, while in the remaining five small intracanalicular papillary cystadenomata were the cause of the hæmorrhage.

Saase in an article upon cysts and cystic tumors of the mammary gland states that the papillary cystadenomata are not related to carcinomata for the adenomatous new-growths do not infiltrate the surrounding tissue and do not extend beyond the walls of the duct which become dilated to form the wall of the cyst in which the papillary cystadenoma lies. As these growths are frequently situated superficially it is quite possible that the skin covering them might become ruptured or thinned so that the growth might extend externally, then a small mushroom or cauliflower-like mass is formed from the papillary cystadenoma. This has happened in some cases in which a cyst situated super-

ficially has been incised and the growth not removed.

The important question regarding these cysts concerns their relation to malignancy. It is difficult to determine how many cases become malignant, for many of the cases undoubtedly benign, were formerly regarded as duct cancers, and the cases were not followed subsequently, so that it cannot be determined whether recurrences occurred or not after operation. Bowlby and Mastermann report three local recurrences in sixteen cases collected or observed by them, but these were local, and were the result of an incomplete operation, rather than an evidence of malignancy.

In a personal communication Bloodgood makes the following statements concerning a discharge of blood from the nipple. His cases are divided into the following groups:

Group A. Cases in which women have had discharge of blood from the nipple without the findings of any tumor. This group can be divided into two classes. **Class 1.** Two cases have been operated upon. The breast was removed in these two cases and a simple papillomatous cyst containing blood found. One case was operated upon fifteen years ago, and the other five years ago. Both patients are well, without recurrences. **Class 2.** No operation was performed. He has had about five or eight of these cases. In all but one the blood has disappeared, no tumor has developed and the patient has remained well. In one case a tumor developed three years later and was removed. It was a cyst with a papilloma and there has been no recurrence after a period of about two years.

Group B. Discharge of blood from the nipple associated with a papillomatous tumor. All of these cases have been operated upon and in all a papillomatous cyst has been found. The majority have been benign. He thinks that in only one or two cases which were malignant was there a discharge from the nipple. From this experience he finds that discharge from the nipple alone is not an indication for operation.

Greenough and Simmons reported 20 cases of papillary cystadenomata of the breast in 1907. In eleven of these there was a serohæmorrhagic or hæmorrhagic discharge from the nipple. Three were malignant, but there is no mention made of a discharge in these three cases. There was one local recurrence in this group. The tumor recurred in the

same situation from which one had been removed and had persisted for four years as another operation had not been attempted,

Rodman regards papillary cystadenomata as an advanced stage of abnormal involution and states that they can usually be differentiated from cancer in a clinical way, because cystadenomata are nearly always situated immediately behind the nipple. The discharge of pure blood, the central location of the cyst, the age of the patient usually forty-eight or forty-nine years on an average, will enable one to recognize it. But Rodman believes that these are potentially malignant from their inception and that a radical operation should be performed. He has found but two exceptions. Of the six papillary cystadenomata that he has operated upon and has records of, four were definitely malignant, two were not. Rodman also reports two cases of bleeding nipple associated with chronic mastitis.

Histological interpretation of the cellular picture presented by a papillary cystadenoma is often difficult. This is indicated, as previously mentioned, by the reports of earlier observers who regarded these as duct and villous carcinomata. If they were carcinomata there have been relatively few recurrences even after incomplete operations.

The character of the discharge, whether serohæmorrhagic, hæmorrhagic, or brownish, apparently gives no clue whether malignant changes are occurring. Some of the benign papillomatous growths have been associated with a brownish discharge. In some instances the discharge has lasted as long as nine years, in one case as long as twelve. One of the cases observed by me showed beginning malignant changes. In this case a discharge had been noted for three months, but a tumor had been present for four. The character of either the discharge or of the tumor did not enable me to make a diagnosis of beginning malignancy as they did not differ from those of a benign papillary cystadenoma. The

granular wall of the cyst aroused suspicion of malignancy when the cyst was incised.

Bleeding nipples are most frequently associated with intracanalicular papillary cystadenomata and the adenocystic type of chronic mastitis. The papillary growths occurring in the acini or ducts are essentially the same and the papillary cystadenomata should be regarded as a part of abnormal involution, although not necessarily as a late stage. That the papillary cystadenoma may not be single is indicated by Saase's report. In only one of five cases observed by him were there no evidences of changes in the breast with the exception of the cyst. Even in this case a statement cannot be made concerning the portion of the breast which was left, for only a small part of the breast immediately adjacent to the papillomatous cyst was removed.

A plastic operation should be performed in most of these. It should be performed, unless there are evidences of malignancy. The changes associated with malignant degeneration, I believe, are quite definite and can be determined by gross appearance when such a cyst is opened. I believe that an operation should be advised even when there is no evidence of a tumor for in these cases a small intracanalicular papillary cystadenoma will be found deep down in the ducts. The portion of the breast in which the growth lies can be determined by the increase of the discharge when pressure is made.

REFERENCES

- SAASE, I. Ueber Cysten und cystische Tumoren der Mamma. Arch f klin Chir, 1897, lx, 1.
 TILTZ, Ueber das Cystadenoma Mammar (Schimmelbusch) und seine Bezeichnungen 2. Carcinom der Brustdrüse. Deutsche Ztschr f Chir 1900 lvi, 512.
 SAAR, Ueber Cystadenoma Mammar und Mastitis Chronica cystica. Arch f klin Chir 1907 lxxxv, 223.
 GREENOUGH and SIMMONS, Papillary cystadenomata of the breast. Ann Surg, Phila, 1907, February.
 ROSSIGNOL, Carcinoma of the Breast. Reprinted from Murphy's Clinics 1915, iv, No 2.
 BLOOMOOD, The clinical and pathological differential diagnosis of diseases of the female breast. Am J M Sc 1908 cxxx, 157.

DERMOID TUMORS OF THE MOUTH

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THE submental dermoids, those situated below the mylohyoid muscle, and the sublingual dermoids, those developing between the genioglossi and the geniohyoid muscles, at times offer difficulties of diagnosis especially if the tumor has attained any considerable size, when the source from which it originated may be impossible to determine. The larger number are found in the latter position, at times extending deeply into the substance of the tongue and accompanied by a greater or less degree of deformity of that organ.

To the presence of a submental dermoid is due at times the condition of a double chin, the extent of the chin depending upon the size and shape of the cystic growth. The skin overlying such a growth is not changed or immobilized, the tumor mass itself presents a smooth, regular surface, is painless, and on firm pressure gives one the sensation of feeling a bag of putty. This doughy mass pits under firm pressure with the finger tip. Unless this variety of tumor has attained considerable size it can be appreciated through the mouth only by pressing upward below the growth which brings it into view beneath the tongue.

The sublingual variety of dermoid on the other hand is first made out through the mouth and it is only when this tumor has attained a size of several centimeters that it may evidence its presence submentally. When either variety has attained a size of eight or ten centimeters it is difficult, if not impossible, to determine whence the growth originated the deformity manifesting itself both within the mouth and below the chin. The enlargement in the latter type of dermoid never manifests itself to the same extent below the chin as does the submental tumor.

The mucous membrane over the sublingual dermoid is freely movable and does not present the grayish color or transparent appearance peculiar to ranula although the same symptoms as those of a ranula may be present

due to the mechanical disturbances produced by the growth. These symptoms include speech and respiratory disturbances and later difficulty in swallowing as the displacement and interference with the movements of the tongue become marked. At times it is impossible to distinguish between a dermoid of the sublingual variety and a ranula, although the color and transparency of the latter and its position more to one side of the median line are suggestive of ranula, as is the doughy feel and pitting on pressure more suggestive of dermoid. A dermoid of this locality may present to one side of the median line though not often.

Dermoids of the mouth are usually met with in adult life in spite of the fact that they are congenital structures. This is due to the fact that the growth is slow and painless and attention is not called to the cyst early unless there is some difficulty in nursing on the part of the child.

The case here pictured (33069, F. Y., 1915) occurred in a Filipino aged 26 years, married and a housekeeper, who came to the clinic at the Philippine General Hospital complaining of a swelling in the neck and under the tongue which caused difficulty in talking and almost entire inability in swallowing.

The patient's family and past history is of no importance nor, on routine examination, did any other abnormality present.

The first intimation of any trouble the patient had was about ten years before coming to the hospital at which time a small rounded swelling under the tongue was felt. The patient at first believed this to be a boil but no pain was felt and the swelling has continued to enlarge gradually till the present time.

Examination shows a well developed but poorly nourished woman. As is seen in the accompanying photographs the patient is unable to completely close her mouth owing to the size of the cyst which fills the oral cavity nearly completely, pushing the tongue upward and backward until only the tip of the latter may be seen when it is protruded as far as possible (Fig. 2).

The tumor was immovable, smooth of a doughy consistence and connected with neither the skin of the neck and chin nor the overlying buccal mucosa. The opaque bluish color seen in ranula was not present over the portion of the swelling



Fig 1 Dermoid cyst



Fig 2 Dermoid cyst Tongue protruded as far as possible

presenting in the mouth, there being little change from the normal color of the mucous membrane covering. An attempt to aspirate the cyst was unsuccessful even though a large needle and syringe were used.

An incision along the median line over the greatest curvature beneath the chin was made and shelling out the cyst attempted. This was found impracticable on account of the intimate relation existing between the cyst wall and the surrounding tissues, so the cyst was opened and several ounces of typical dermoid content evacuated—thick, putty

like, whitish material of a semicrystalline structure readily soluble in ether. As much of the wall of the collapsed cyst was removed as could be readily detached, the remaining portion was cauterized with carbolic acid and the contracted cavity packed with gauze.

Recovery was uneventful, the gauze being removed as the cavity contracted, and healing occurred promptly with a complete return of function of the tongue and mouth floor. The patient gained in weight as it became possible to increase her diet.

HEREDITARY SYPHILIS AS AN ETIOLOGICAL FACTOR IN SPURS ON THE OS CALCIS

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SINCE attention was first drawn to exostoses or spurs on the plantar surface of the os calcis as one of the relatively common causes of foot disability, their etiology has been shrouded in mystery, their treatment an embarrassment to the surgeon.

Blencke who studied six hundred normal individuals found that spurs were present on the os calcis in 28 per cent of the cases. Very often they give no symptoms until some trauma occurs such as falling and striking on the heel.

Murphy (1) in presenting a case in a recent number of his *Clinics* states that such formation is the result of some constitutional toxin. He refers to the idea prevalent in France that many exostoses are due to gonococcus infection though he also thinks that probably there is a variety of causes. In the case under discussion he reports that tuberculosis as the causal agent was excluded by the fact that the patient did not give a focal reaction to tuberculin though he gave a marked constitutional reaction. No mention, however, is made of the possibility that syphilis in any form may be an etiological factor.

Meisenbach (2) in a very careful article presents the results of his observations in twenty cases. From the history and X-ray findings he concludes that the cases can be grouped into one of four types, namely, infectious, traumatic, syphilitic, and osteoarthritic. In the discussion of this paper Hoffman expressed the opinion that these spurs were merely the result of a general inflammatory process of the os calcis or of the os calcis and other bones. Cone and Ryerson (2) both called attention to the fact that operative removal was often unsuccessful because of the recurrence of the spurs and they seemed to believe that this recurrence was due to

hyperemia of the os calcis at the site of the spur formation, following the trauma of removal. Murphy (1) believes that an accompanying bursitis is the cause of the pain rather than the spur *per se*. No one who discussed Meisenbach's paper made any reference to his suggestion that syphilis might play a part. It is frequently mentioned that relief cannot be obtained by removal, if the accompanying bursa is not excised as well. The operative treatment, however, was not universally recommended by Meisenbach (or by those who discussed his paper), the idea being that protection should be first attempted.

The present paper is based on a study of nine cases, in three of which the symptoms recurred after temporary improvement, following the removal of the spurs. In the other six, no operations were performed. The diagnosis was confirmed in seven cases by X-ray negatives.

As the result of the study of these cases of spur formation it is our belief that hereditary syphilis is responsible for many of these exostoses. As will be apparent the study of the family history suggests, lues more frequently, perhaps, than does the examination of the patient himself who rarely presents any obstructive signs of hereditary lues, though a very careful examination will often reveal some thing that is suggestive. It will also be observed that the Wassermann test was negative in all the cases.

CASE 1. A man aged 33 had always been in good health except for a Neisserian infection a good many years ago. Three years previous to examination he began to feel pain in his heels. This pain persisted in spite of various therapeutic measures. Finally the true nature of the condition was revealed by X-ray pictures. The spurs were then upon removal but the pain recurred.

As the patient had had gonorrhoea our first

thought would naturally be that this was the cause of his trouble. He was a very robust, well nourished man, and presented no signs of hereditary syphilis except that his tongue contained many deep and irregular fissures. The skin of the whole body was exceedingly dry, which condition had been present also in at least two other generations. His mother and one brother were living and said to be well. The possibility of hereditary syphilis was suggested by the fact that his father died at the age of 53 of Bright's disease. A high percentage of individuals who die a cardiovascular-renal death, in middle life, are infected with syphilis and their children frequently have some manifestations of hereditary lues. The Wassermann reaction was suggestive only (one plus, 25 per cent inhibition), though the leutin test was very positive.

Although all his old symptoms recurred within a few weeks after the removal of the spurs his improvement under injections or mercury, iodide of potassium and salvarsan has been very marked.

CASE 2 A young man of 20 first noticed pain in his left heel about two years ago as he was walking. As he was a clerk at this time he attributed it to being on his feet. The soreness, however, constantly increased. Of late he has noticed pain in his knees and hip joints. When seven years of age he had an attack of "rheumatism" at which time the knees and ankles were swollen. He also had some pain in his hips and occasionally in the shoulders, this attack was of several months' duration. Fourteen years ago he again suffered from "rheumatism" in his hips and knees. This attack lasted about a year. Several years later he again suffered from an attack which was of three or four months' duration. In all he has lost nearly three years of school work, because of his "rheumatism" attacks.

He had never had any venereal disease. His mother and one sister are living and appear to be well. His father, however, died at 58 of apoplexy. Aside from being a tall, poorly nourished individual whose teeth have been neglected, his physical examination was negative, except for the left heel which was swollen, tender but not reddened on the posterior and under surfaces.

Spur formation on the os calcis was demonstrated by the X ray picture. No operative measures were undertaken, as he gave a positive leutin test, though a negative Wassermann. He was put on weekly (1 gr.) injections of salicylate of mercury, and iodide of potassium and later he received one injection of salvarsan.

On August 31, 1915, at which time he had been under treatment exactly nine months he stated that he had been working as a clerk all summer long and had been constantly on his feet without discomfort. One year ago he was not able to stand up continuously for one half hour, because of pain. He experiences no pain now, except after a long tramp, when he has slight pain across the upper part of his heel.

CASE 3 A widow of 39, whose husband had died

from pneumonia, complained of painful feet. Her father died at 46 of "shock." Her mother at 50 of "smothering" spells. She had one child which is said to be well, and has had no miscarriages. Many of her teeth were black and eroded on their labial surface. This condition had prevailed since childhood. This discoloration, generally attributed to medicine, is usually due to hereditary lues. Figure 2 shows the X ray findings. This patient had been operated upon six months previous to this note and the symptoms had recurred. The leutin test was strongly positive so it was deemed advisable to put her upon specific treatment before operating again. For the first three weeks of treatment with potassium iodide and salicylate of mercury, no improvement was noticed, as a matter of fact, the patient complained because she had pain and stiffness in her hands and her right elbow, which had previously given her no trouble.

Shortly thereafter, however, definite improvement was noted and six weeks later she had substituted a number six shoe for a number eight, which she had been compelled to wear for the past four months. She still favors her heels slightly, when walking, but has made very definite improvement.

CASE 4 A boy of 10, with a negative family history who had had no venereal disease, first noticed pain like "knives in his feet" some eighteen months ago. This was so severe that it interfered with his work and the removal of spurs which were found to be present (Fig. 2) did not give the desired relief. He was unhealthy in appearance and the only thing at all suggestive in the physical examination of hereditary syphilis was the fact that the right upper lateral incisor was very small and the left upper was lacking. As the patient has no recollection of losing this tooth, it is probable that it never erupted. While not the sole cause of the dental dystrophies and hypoplasias, hereditary syphilis appears to be by far the most common etiological factor. A Wassermann was not made, but he gave a strongly positive leutin test.

Improvement promptly followed mercury injections and the administration of potassium iodide. He is now walking to and from his place of work which is a distance of about one mile, with comparative ease. His mother recently said that he no longer had pain in his heels.

CASE 5 A man of 46 had enjoyed good health up to eighteen years ago, when he began to suffer from "rheumatism" in his hands and feet, but especially in the latter. About a year ago the "rheumatism" in the feet became much worse and has been nearly constant since then. He was compelled to give up his occupation, which necessitated being on his feet constantly, because of this pain and weakness which would require the rest of a week or two after two days' work. Eighteen months ago an X ray picture (Fig. 3) showed spurs on both heel bones. As the pain was especially marked in the heels, these exostoses were removed, but his symptoms returned after the operation. About seven months ago it



Fig. 1. Case 3. These sharp spurs were removed and the temporary relief was followed by a relapse which was entirely cured by specific treatment.

was discovered he had sugar in his urine, but it has not been present in several examinations since then.

A few years ago he drank to excess and twenty years previously had gonorrhoea. His father died at 62 of heart disease. Two brothers and a sister are living. The mother and one sister are said to suffer from "rheumatism." The patient's systolic blood pressure is in the neighborhood of 165, and he has a harsh systolic murmur at the base of his heart. X-ray pictures show dilatation of the arch of the aorta and calcification of his tibial arteries. Reflexes and pupils are normal.

Both lower lateral incisors presented on their anterior surface, pin point areas of hypoplasia near their dorsal surface. Many of his sister's teeth are lacking and the remaining incisors are peg shaped and they and the canines show the same hypoplasia which is usually due to hereditary syphilis.

His Wassermann reaction was negative, spinal fluid also negative, luetin very positive. There has been very satisfactory improvement not only in the "rheumatism" but especially in his general condition since he has had several injections of salvarsan and mercury. He states he feels better in every way. Six months after treatment was begun he was working as a waiter and said his feet were "first rate."

Three other cases of spur formation on the os calcis have presented themselves, and because of the interesting features in the family histories it is thought desirable to include them in this report though sufficient time has not elapsed to definitely determine the results of specific treatment.

CASE 6. A housewife age 40 was seen September 24, 1915. She complained of pain in the bottom of both heels present for six months and had not

been relieved by untiring efforts with supports, orthopedic shoes and static electricity. Her father died of Bright's disease at 64. Her mother died of locomotor ataxia at 54. This patient though she appears well nourished and robust has perfectly white hair and says she has been ill all her life. She has suffered with repeated attacks of headaches ever since childhood. Her feet were slightly pronated and exquisitely tender under the ossa calcis. She has been provided with supports intended to remove pressure from the os calcis and has been started on specific medication which had hitherto been denied her because her Wassermann was negative. A luetin test was made in October, and it was positive. Specific treatment has been energetically pushed and the family physician reported on December 15 that the feet were practically free from pain and that the attacks of headaches, from which this patient had suffered all her life, were greatly lessened in number and frequency.

CASE 7. A woman of 40 injured her right foot and ankle in September, 1913, and was seen in July 1914. She said that the injury consisted "in a torn muscle in her leg" that this injury had not been fully relieved, and that she was unable to use her leg because of continuous pain. The examination was entirely negative, except that the patient was prematurely gray and the leg was atrophied one inch. The Wassermann test at this time was negative, as it so often is in adults with hereditary syphilis. The symptoms persisting, this patient has recently been re-examined, and the left tibia presents anteriorly a cortical enlargement of the shaft, which when fully developed, becomes the so-called "saber case" tibia. On the under surface of the left os calcis, there is a small spur (Fig. 4) which is quite painful. This patient's family history is as follows: Her father died at an advanced age but had been lame for years and suffered from "growing pains" in his legs so severely that he would have to walk the floor at night. Her mother died of diabetes. The mother's first child a son is insane.



Fig. 2. Case 4. These large spurs were removed. The pain promptly recurred. The patient is now entirely well after energetic specific treatment.

the second pregnancy was a stillbirth. The patient here described was the third child. The next child died of cholera infantum and the last at 20 of "stomach trouble."

Active specific treatment was begun in October 1915 and by the first of January, 1916, all the symptoms in the tibia and in the os calcis had disappeared. The patient is now able to walk about without discomfort though she had been confined to a wheel chair, and crutches for at least a year.

CASE 3. A housewife aged 40 presented herself two weeks ago complaining of "rheumatism" in her feet. Upon examination it was quite evident that this "rheumatism" consisted of the largest and most painful spurs imaginable. The family history contains much of interest.

The father is living and is 65. When in his forties



Fig 3. Case 3. The arrows indicate the spur formation on the under surface of the os calcis. Note particularly also the very slight beginning spur on the posterior surface of the right os calcis. The uppermost arrows indicate the highly sclerotic posterior tibial arteries present in a man less than 50 years of age.



Fig 4. Case 7. This spur occurs in company with a cortical thickening in the tibia.

he had such terrible "throbbing headaches" that he would have to go to bed for half a day. The mother is living and is 63. All her life she has suffered much from "rheumatism", first of the left hand then both knees. Five years ago when 38 years old a diagnosis of Bright's disease was made. She has been an invalid most of her life as the result of "rheumatism." She was pregnant four times, the patient under discussion being the first child. The patient since childhood has suffered from Raynaud's disease which has badly deformed the finger tips. At one time when about 30, an obscure skin lesion responded to specific treatment. About two years ago she began to experience pain in her heels upon getting out of bed in the morning. It is for this condition which had increased that she came to the hospital. There is nothing to be detected in the woman's physical condition aside from her hands and feet. The distal half of all her fingers are of a purplish white and the distal phalanges are short and stubby in appearance. The under surface of the heels is tender to the touch, and a bony growth can be felt.

The pregnancy succeeding this patient resulted in a miscarriage, the next in a living child, now 34, in good health and she has three healthy children. The youngest sister, age 34, has had several attacks of nervous prostration. When a young girl she was subjected to severe "growing pains" and severe headaches. She is still subjected to sick headaches accompanied by vomiting.

The patient's husband is living and well. The patient has been pregnant six times, the first resulted in a "blue baby" which died 24 hours after birth, the second in a boy living and well, age 7 years. The next pregnancy resulted in a miscarriage, the fourth in twins living and well, age 5 years, the fifth, a "blue baby" lived six hours, and the last pregnancy was a miscarriage.

Wassermann reaction was negative, luetin, plus.

The last case is of special interest because the family history suggests the possibility of syphilis in the maternal grandparents and

in one-half of the number of children in their family. The history is as follows:

CASE 9. A man of 36 was operated on for spurs on the os calcis in the Hartford Hospital, on September 26, 1915. He was better for a time, but the symptoms subsequently recurred, and he returned for relief of pain when walking, in October, 1915. He has always enjoyed first rate health, and there is nothing in his physical examination to suggest hereditary syphilis. Several years ago he had gonorrhea, but no chancre.

His father is 64 years of age, and said to be in good health. The mother is 60, and she suffered a great deal from some illness at the "change of life," the nature of which is not clear. Some operation was performed.

For a number of years she suffered very much from severe headaches. The maternal grandfather died at 50 of liver complaint (syphilitic cirrhosis?), the maternal grandmother at 68 from a "stroke." The first stroke came at about the sixty fifth year. She had ten children, one of whom died in infancy. Nine lived to grow up, two were mentally deficient, and had "fits," and died at about forty. Two living are mentally deficient, and another, who though not mentally deficient, is nevertheless subject to "fits." The mother of this patient, who is the second oldest child, has had fifteen children, all but one of whom are living. They are stated to be in good health but it has not been possible to examine any other member of the family for evidence of syphilis. The data, however, is very suggestive of syphilitic ancestors.

The X-ray picture made in October, 1915, shows a spur on the under surface of the os calcis, and appears to show that the spur on the posterior surface has enlarged since the first picture was made. Active specific treatment was begun at once and on February 1, 1916 the pain on the under surface had ceased, and there was less pain on the posterior surface.

We realize that this series of nine cases is too small to warrant any definite conclusions. In all but one case, however, the family history was very suggestive of syphilis. The Wassermann test even with cholesterinized antigens was uniformly negative. It seems clear, however, that as the results of specific treatment were so uniformly conclusive, we are warranted in assuming that in these cases, at least, hereditary syphilis played an important part in the etiology. It is worthy of notice that in three of the cases a previous removal of the spurs was followed by a relapse, and that the symptoms were cleared up in each by specific treatment.

From our experience, therefore, it seems evident that certain cases of spur formation on the os calcis are the result of an inflammatory process, for which hereditary lues provides the underlying cause. The pain in such cases is occasioned by the inflammation, and disappears as the process subsides under treatment. It cannot be said, therefore, that the pain is primarily due to an accompanying bursitis, as was suggested by Murphy. Moreover, it would appear that the operative removal of such spurs of the lentic type is necessary only when they cause pain in adjoining tissues by their mechanical presence.

REFERENCES

1. Clinics of John B. Murphy, 1915, ix, 50.
2. MEISENBACH, R. O. *Am. J. Orth. Surg.* 1911, ix, 427.

THYROID TUMORS OF THE BONES

WITH SPECIAL REFERENCE TO NON-MALIGNANT PULSATING TUMORS OF THE SKULL

By J. PHILLIP KANOKY, M.D., KANSAS CITY, MISSOURI

THYROID tumors of the bones are of two types. The first and most frequent are metastases of malignant growths of the thyroid, the second, thyroid tumors where the thyroid appears normal, or where there is a goiter of a clinically benign type. Some authorities deny the possibility of metastases of a normal thyroid or of a benign growth, and hold that in the cases reported, there was, in reality, a beginning malignant process which was but slightly advanced and so overlooked.

Other points to be noted are that although some of these thyroid tumors are pulsating, all are not and that other bone tumors chiefly sarcomata may pulsate, so that pulsation cannot be regarded as a characteristic symptom of these tumors. In fact clinically they cannot be distinguished from other bone tumors and their true character is revealed only on histological examination.

The following quotations from various recent authors indicate the present state of our knowledge of these tumors and the points at issue.

Beilby, writing in 1907 says

There are now in the literature records of about 20 cases of tumors apparently metastases from the thyroid, which were histologically benign. As in a number of instances there has been no apparent thyroid lesion these cases have been considered as metastases from normal thyroid tissue. Where a thyroid lesion has been observed it has been that of simple hypertrophy or adenoma and the metastatic tumor has had a similar histological structure. These metastases which may be single or multiple have occurred most frequently in bone and have often been removed under the supposition that they were primary growths. Aside from the fact that these tumors are probably of metastatic origin they present as a rule no other indication of malignancy. Frequently however they have been known to recur after removal and a number of cases have thus resulted fatally.

The fact that we have in these metastatic tumors structures similar to or almost identical with the tissue found in the normal gland lends special interest in the etiology of these tumors. In its con-

sideration several factors may be taken into account.

1. Origin from misplaced embryonic tissue. The theory which has been advanced by Cohnheim in which he regards the etiology of malignant growths as due to misplaced embryonic cells might be applied to tumors of this class.

2. Origin from aberrant or accessory thyroid. Murphy calls special attention to a group of accessory thyroid glands at the base of the tongue.

He records 39 cases¹ (of tumor).

3. Propagation of bits of thyroid tissue through the circulatory system. It is a well known fact that certain tissues, especially young embryonic cartilage when transplanted into different tissues of the body or when injected into the circulatory apparatus, are apparently nourished and in certain instances continue to grow. An apparently analogous condition is true of the thyroid gland. Although no proof is at hand, it is possible that these metastatic tumors could result from small particles of thyroid tissues which had found their way into the circulatory apparatus and had been transferred to distant portions of the body. In an organ as vascular as the thyroid such a condition is not inconceivable, especially under conditions of trauma.

Dr. Blumer in his article on "Tumor Metastases in the Bone" says

The thyroid tumors which give rise to bone metastases present some very marked peculiarities. While some of them are very evidently malignant, judged from their clinical manifestations alone, others show none of the ordinary evidences of malignancy.

An analysis of 62 cases from the literature shows that two thirds of the thyroid metastases occur in women and 90 per cent of the cases between the ages of thirty and seventy. No obvious clinical involvement of the thyroid is present in at least 25 per cent of the cases, when enlargement occurs it is often apparently an ordinary goiter which may have been present as long as thirty years before metastases appeared. It is important to note that metastases may not appear until three or four years after the surgical removal of the gland. Clinically two thirds of the metastases are of the solitary type and even at post mortem multiple metastases are the exception.

So far as distribution of the thyroid metastases is concerned, 38 per cent of them occur in the bones of the cranium or face, 16 per cent in the vertebrae,

¹ These are not bone metastases.



Figs 1 and 2 Photographs showing author's case

10 per cent in the femur, 9 per cent in the pelvic bones, 7 per cent in the sternum and 5 per cent in the humerus. Of the facial metastases, seven out of nine are in the lower jaw. Spontaneous fractures occur in 9 per cent of the cases, and the spinal type in 10 per cent. The slowness of the growth of bone metastases is in some cases most remarkable and makes them unusually favorable for surgical removal. In one instance, a tumor of the maxillary bone had been present for thirteen years, in another instance a tumor of the sternum had been present for seventeen years and in still another case a tumor of the lower jaw had been present for ten years. Growth may be greatly accentuated by trauma or the metastasis may first appear with the trauma.

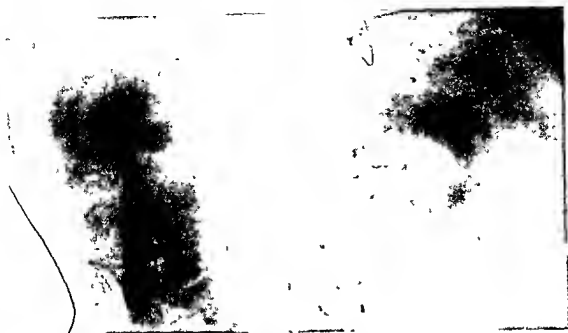
A very important fact in connection with the thyroid bone metastasis is that clinically no change in the thyroid gland may be detected even on the most careful scrutiny. It is true that detectable small tumors may be overlooked clinically simply because the thyroid was not thought of. In a case I saw with Dr. Turnbull in San Francisco there were large bony tumors of the clavicle and pelvis, and a perfectly definite tumor the size of a cherry in the right lobe of the thyroid without any enlargement of the neck. Still, when the tumor is the size of a pea, as has been reported, it is not surprising that it is overlooked.

Compared with some bone metastases, those from the thyroid gland frequently show a comparatively low grade of malignancy. As a rule thyroid bone metastases are exceedingly vascular and some of

them pulsate. For this reason they have occasionally been mistaken for aneurysms, particularly those involving the sternum, pelvis, and skull.

Dercum says:

The question as to the malignant character of the enlargement of the thyroid gland in cases of metastasis, is one that cannot be regarded as settled. However, it is very suggestive that among the 18 cases collected by Patch, 13 were regarded as benign by the authors reporting them. In the remaining 5 the benign or malignant thyroid enlargement is not mentioned. In the present state of our knowledge the problem can only be answered in a speculative way. It appears that simple hypertrophy plays no rôle in the etiology of thyroid metastasis. Patel calls attention to the interesting fact that it is particularly in the colloid goiters that metastasis occurs. They especially present diffuse cellular proliferation and it is readily comprehensible how under such circumstances metastasis could occur. Further, goiters that are decidedly cystic present also vegetations in their interior and these may break down. That fragments should thus find their way into veins and capillaries, does not seem strange. Still, it is remarkable, inasmuch as colloid goiters are relatively common, that thyroid metastasis does not occur more frequently. Wolfer maintains that if a metastatic growth not only increases in size, but also takes on a destructive action of the bones, the primary tumors cannot be considered benign, not even when clinical, anatomical, or even



Figs 3 and 4 Radiograms of author's case

histological investigations have failed to establish their malignant character. As Patel points out if the metastasis be benign, we will observe the typical structure of the thyroid gland. If on the other hand the metastatic formation be malignant, we will probably find side by side with normal thyroid vesicles areas in which are found irregularly shaped cavities crowded with epithelial cells of the same type as those which line the vesicles but irregularly arranged, heaped in rows of disordered accumulations.

Muller and Speese state that according to Ehrhardt "metastasis is observed in 85 per cent of the reported cases of malignant goiter where an exact autopsy record exists." Ehrhardt gives 238 cases of malignant disease of the thyroid gland to which the above named authors add 19. Of these there were metastatic tumors in the bones in 49 cases of carcinoma and in 24 cases of sarcoma. The bones most frequently affected were those of the skull and inferior maxilla, next in frequency sternum, vertebra, rib, femur, humerus.

These authors say

Metastasis to bone is not only a frequent but a very interesting complication of these malignant

¹ *Bull. A. M. Ch. S.* 1902 XXXV 243

thyroid tumors because this organ together with the breast and the prostate are practically the only ones in which metastasis to the bone is commonly observed. Another peculiarity is the frequent presence in the metastatic bone tumor of colloid material contained in normal or abnormal vesicles, in practically all cases, of course, the primary tumor being a carcinoma not a sarcoma.

Regensburger in a recent article, August, 1912, says that he found record of 59 cases (besides his own) of thyroid metastases in the bone in which there were no symptoms indicating the malignancy of the thyroid, although many authors believe that such malignancy must exist before metastases can form. He holds, however, that it is possible owing to the thyroid's close relation with the blood and lymphatic system, that cells of a healthy or at least a non malignant, thyroid may be transplanted to other parts of the body.² He does not review these cases in detail, so there is nothing to indicate how many of them were pulsating.

He also notes other cases (number not stated) of bone metastases in which there was a primary malignant growth in the thyroid, mostly carcinoma, in which the struc-

² See also case reports under 1912 Regensburger

ture of the metastases varied from that of normal thyroid tissue to perfect medullar carcinoma

He states that in his dissertation published in Strassburg in 1911 he reviewed the subject and the literature in detail but this publication is not obtainable here

Dr. Simmons says

There are seen at times solitary or multiple bone tumors which are composed of typical adenomatous thyroid tissue and yet which are not necessarily accompanied by goiter. These tumors are most commonly seen in the sternum, vertebrae, humerus, and skull. As regards their origin there is considerable difference of opinion. Hermann Orlersfeldt, Steinhaus and others consider them as being examples of metastasis occurring in a benign tumor, that is a simple adenoma of the thyroid, while von Recklinghausen, Huguennin and with them the majority of observers consider them as metastases of a microscopic malignant thyroid tumor that has been overlooked and there is nothing in the reported cases to disprove this. The possibility of their being in some cases embryonic inclusions is to be thought of. Von Fraenkelberg in 1903 reported 8 cases the tumors being multiple in 3 instances

Simmons makes no mention of pulsation as a symptom of these tumors but he states that they are "very vascular," and in the same article speaking of bone sarcomata, he says

"A certain number of these tumors on account of their vascularity have a distinct pulsation." This would indicate that the thyroid tumors might also pulsate

Sutton in the latest edition (1911) of his book says

The term general thyroid malignancy is applied to a rare but very remarkable form of disease, in which tumors structurally identical with the thyroid gland appear in the bones. The fact which invests them with more than ordinary interest is that they live in nearly all instances been associated with an obvious enlargement of the thyroid, which clinically is indistinguishable from the common kind of enlargement known as parenchymatous goiter. The earliest cases were observed by Cohnheim and Morris

Since 1880 a score of cases have been described and from the records, the following facts may be stated

The tumors occur most frequently in women (five to one), and are most common between the fortieth and sixtieth years, but one case has been observed as early as the twenty-seventh year. They show a striking preference for the skull but

have been observed in the femur, clavicle, sternum, humerus, and on several occasions in the vertebrae

In some of the patients the secondary tumors are large and pulsate. In the extraordinary case described by Cramer the secondary mass occupied the sternum, and pulsated so markedly and caused so much pain that it was mistaken for an aneurism this induced the surgeon to ligate some of the large vessels

In England the chief cases have been observed and recorded by Haward, Coats, Horsley, and Leducard. Goebel has collected the German literature in an interesting paper, and has shown that in many instances these tumors have been subjected to operative treatment, and on the whole with satisfactory results

I think the explanation of this interesting condition may lie in the fact that in the early stages carcinoma of the thyroid is such an insidious disease, and mimics so closely the innocent bronchocoele, that the primary disease is overlooked. This view receives some confirmation from the fact that a very similar condition of things is sometimes associated with carcinoma of the prostate

The following interesting case was referred to me by Dr. B. H. Zwart of Kansas City. first because of slight skin disease of minor importance, second a peculiar pulsating tumor on the left side of the patient's head. Upon examination I pronounced the case a pulsating tumor of the brain probably due to displaced thyroid cells. The following history was obtained from the patient.

Miss A., age 40, white, native of the United States was examined January 4, 1913. At the age of 20 years she noticed an enlargement of the right and front side of the neck. For several years afterward it was treated with various external applications without result. In 1903 the growth which had become quite large, was diagnosed as goiter, and injections were advised by the attending physician. Two injections were administered a week until 31 treatments were given. (The injections are believed to have been phenol and iodine). The treatment resulted in sclerosis of the gland. The growth did not decrease during or after the treatment

Because of the implication of the inferior laryngeal nerves the patient had spasmodic attacks of dyspnea. An operation for the extirpation of the gland was advised. This was done in March, 1903. The growth was successfully removed and proved to be an intrathoracic goiter involving only the right lobe of the thyroid gland

The patient made a speedy recovery and remained in most excellent health until February, 1910. At this time she felt a tumor like growth about as large as a hazelnut on the left side of her head. The point indicated was about 2 1/2 inches above and

on a line with the auditory canal. She had suffered no pain, headache, or nausea. There was a stiffness and slight pain at the junction of the angles of the left side of the inferior maxillary with the skull. This stiffness was noticed only when she attempted to eat. May 10, 1910, the tumor had increased to about one inch in diameter. At this time she consulted a surgeon in Chicago who advised removal of the growth.

Operation. An incision was made, the resulting hemorrhage being so great that the most strenuous efforts were required to save the patient from dying on the table. The growth was not removed, the patient made an uneventful recovery and returned home. The tumor continued gradually to enlarge. The patient remained in good health except that she had occasional slight headaches up to about May, 1912, when she experienced a slight tenderness of the scalp and a feeling of soreness in the head. Two days prior, before the pain complained of, she had nausea and vomiting. These symptoms became gradually aggravated until May 14, pain, soreness, and pressure sensation in the left posterior occipital region became very great. May 12, she suffered with nausea for three days and then began vomiting more or less continuously for a day and a half. About May 17, vomiting ceased and she became unconscious and remained so for 36 hours when complete consciousness returned. She had extreme tenderness and pain on the left side and back of the head for two or three days. Before she lost complete consciousness, the right arm and leg were found paralyzed. Two days after consciousness returned the patient had a hemorrhage from the left nostril and mouth (arterial blood). The hemorrhage lasted two or three hours, at this time the patient was also menstruating. After the cessation of the hemorrhage, menstruation ceased. Shortly after the return of consciousness the paralysis that had affected the left arm and leg subsided simultaneously with the pain in the head. The scalp and head in and around the affected area felt very sore for some days.

October, 1912, the left eye had protruded very markedly showing pronounced symptoms of exophthalmos. January 10, 1913, Dr. J. H. Thompson made the examination of the eyes and reports as follows: None of the muscles of the eye affected, motion of the eyeball or lids as found in exophthalmos. In right eye pupil responded to light, apparently not affected. Vision absent in left eye. The blindness in left eye was apparent after she returned to consciousness. The exophthalmos in the left orbit was of an extreme degree, the eyeball being pushed straight out. There was no paralysis of any of the ocular muscles. No ptosis. There was some congestion of the upper lid and some conjunctivitis, a condition such as would obtain in tumors of the orbit. The left eye's blindness was due to atrophy of the optic nerve. Although the nerve head was white it did not show any evidence of previous inflammation. Therefore, the atrophy

was considered a pressure atrophy, as the tumor had penetrated into the left orbit. There was no pulse in the retinal arteries but a marked venous pulsation. The retinal veins were not engorged. The eyeball pulsated synchronously with the pulsation of the tumor.

The right eye appears normal, no tumefaction, no exophthalmos, no ophthalmoplegia. Vision 20/40, visual field normal. She complained of transitory attacks of blindness, coming on as frequently as every hour, and then shortly disappearing. The only abnormal condition of the right eye was an acute optic neuritis with retinal hemorrhages, the so-called choked disc.

For the purpose of determining the condition of the bony structure of the head at the seat of the tumor, Dr. E. H. Skinner made the appended skiagrams and reported as follows:

Two exposures were made of Miss A's skull, one in the postero anterior, and one in the lateral position.

The findings are as follows: There is a deficiency of bone in the left temporal area extending from a point one-half inch behind and above the external auditory canal to the external rim of the orbit a distance of nearly three inches. The vertical diameter of this space in the temporal bone is about two and one fourth inches. The upper edge of this space is about one half inch above a horizontal line touching the external angular process of the frontal bone.

Within the diploe of the parietal and frontal bones there are numerous venous channels which are very much enlarged over the normal size and all of which seem to have their direction toward the upper part of the involved area of the temporal bone.

There is no shadow of the external wall of the orbit. The lesser wing of the sphenoid and orbital plate of the malar bone have apparently vanished. No shadow can be seen of the sphenoidal fissure or the optic foramen upon the left side. All that remains of bone upon the outer external side of the eye is the rim of the orbit.

The antrum of Highmore upon the left side contains no air. The other accessory sinuses of the nose all contain air and cast normal shadows.

To sum up the X ray findings, we may say that the squamous portion of the temporal bone and a portion of the lateral plate of the frontal bone, anterior thereto, has disappeared through pressure necrosis. That portion of the lesser wing of the sphenoid and the malar bone which form the external walls of the orbit have likewise disappeared and accounts, therefore, for the extreme condition of exophthalmos present in the case. The increased size of the veins within the diploe is a sign of intracranial pressure (Figs. 3 and 4).

The clinical pathological report by Dr. Frank J. Hall follows:

Urine, specific gravity 1.003, light amber color,

reaction sharply acid, no albumin; no sugar; indol, negative, no casts; no red blood-cells, a few leucocytes, no crystals, squamous epithelium, no mucus, nondescript bacteria.

Blood red blood-cells, 4,000,000; leucocytes, 12,000, hæmoglobin 50 per cent. Blood pressure systolic 145, diastolic 140.

Report of and the operation by Dr. E. F. Robinson

Owing to the rapid and large growth of the tumor, ligation of the common carotid artery was decided upon, as it was evident that tying the external carotid alone would by no means occlude the blood supply from the tumor. Immediate extirpation was evidently impossible. January 16, 1913, at St. Mary's Hospital, under ether anaesthesia, the left common carotid artery was tied without difficulty, in the superior triangle just above the omohyoid muscles. The veins were unusually large on this side of the neck. Just before reaching the sheath of the carotid vessels, the upper left pole of the thyroid gland was found extending unusually high in the neck along the carotid, and had to be displaced outward and downward before the carotid sheath was opened. The vessel was ligated with No. 2 ten day chromic catgut. Immediately, upon applying the ligature, all pulsation in the tumor ceased and it became cyanotic with a marked pallor to the whole left side of the head and face. There was also a noticeable diminution in the size of the growth.

The left eyeball, which had been so markedly exophthalmic that the contour of the posterior portion of the ball was evident, also became much less prominent and the pulsation of the eyeball ceased.

The patient left the operating table, pulse 96, respiration 19, in very good condition. She was placed in bed with head elevated. Six hours after the operation she had not regained consciousness. At this time it was noted that there had developed a complete hemiplegia of the right side. Urine was drawn by catheter, twenty four hours later her pulse was 84, temperature 100.4°, respiration 19. The condition of coma still existed, but the patient was able to be partially aroused. At this time, however, a slight return of pulsation was noticed along the median border of the tumor for a distance of about one inch. The patient was considered to be in fair condition, when she suddenly died, apparently from embolus, 36 hours after the operation.

No general autopsy was permitted, but we were allowed to remove the tumor. The growth measured 5 inches in diameter and 3 inches antero-posteriorly and protruded $2\frac{1}{2}$ inches laterally from the left temporal region, and a like distance into the cranial cavity.

Before an incision was made several loose, hard particles were felt over the surface of the tumor. These proved to be spicules of bone which were scattered or "infiltrated," over and through the

anterior surface of the tumor. The skull was completely disintegrated for a space corresponding to the growth and thus had extended into the cranial cavity but had not penetrated the dura mater but pushed it before. It was attached to the dura mater at some points and shelled out with some difficulty. It occupied fully one third the left brain cavity. It had evidently arisen from the diploe of the left temporal bone, and had grown equally inward and outward, deriving its blood supply not only from the external carotid and cerebral vessel but from enormously enlarged arteries and veins of the diploe of the skull itself. Its gross appearance carried out the conclusion formed that it was a secondary or metastatic thyroid which arose from the cancellous bones of the skull. The macroscopic appearance was that of the thyroid gland. A number of microscopic sections made were structurally identical with normal thyroid tissue. If there was a trace of malignancy it was not discovered.

OTHER CASE REPORTS

F Cramer¹ reports 3 cases, 2 female, 1 male, of malignant goiter, with pulsating bone metastases.

C Ewald² reports the following cases.

CASE 1. Female, age 45. Goiter of the colloid type, without symptoms of malignancy, removed. A year later a tumor had developed on the right scapula, removed, microscopically a thyroid adenocarcinoma.

CASE 2. Female, age 26. Goiter, clinically of the colloid type. Tumor of the malar bone that was noted by the patient some years previously—before the goiter began to develop. Microscopically the tumor had the structure of the fetal or infantile thyroid gland, with slight proliferation indicating a tendency toward malignancy.

K von Hofmann³ reports

CASE 1. Female, age 69. Small colloid goiter, first discovered at autopsy. Tumor in the upper part of the upper arm, structure the same as that of the goiter.

CASE 2. Female, age 26. Adenocarcinoma of the thyroid gland, metastasis in the malar bone. Both removed. No further report.

CASE 3. Female, age 43. Removal of goiter of the colloid type with no signs of malignancy. Soon after the operation, tumor developed on the right scapula, with the structure of a thyroid adenocarcinoma. Recurrence in about two years, tumor removed again. Death two years later, cause not known.

CASE 4. Female, age 56. Autopsy showed fibro-cellular sarcoma of the thyroid, metastasis in right iliac bone, lungs, etc.

H Oederfeld and J Steinhaus⁴

¹ Beitrag zur Kenntnis der Struma maligna. Arch f Klin Chir, 1887, xxvii, 235.

² Zwei Fälle von Knochentumoren. Wien Klin Wochenschr, 1893, vi, 459.

³ Zwei Fälle von Strumametastasen am Knochen. Wien Klin Wochenschr, 1897, x, 1004.

⁴ Zur Casuistik der Knochentumoren von normalen drüsengewebe. Zentralbl f allg Path u path Anat, 1901, xi, 509, 1902, xiv, 84.

Female, age 58. Diagnosis of sarcoma of the frontal bone. Tumor removed and microscopically proved to be composed of normal thyroid tissue. No goiter, no enlargement of the thyroid. The later article reports recurrence of the frontal growth in a year, with tumors on the right temporal bone, and on the sternum at the sternoclavicular articulation. The right lobe of the thyroid was thickened. Operation and death. In the thyroid a nodule was found surrounded by a connective-tissue capsule, but consisting of normal thyroid tissue except that it was slightly lighter in color. The metastases all consisted of normal thyroid tissue. These authors also note another case cited by Patel 1904.

R Wagner¹ Female, age 48. Spindle cell sarcoma of the thyroid gland, metastasis in the left femur.

E. Gierke² reports 2 cases.

CASE 1. Man, age 57. Paraplegia and girdle pains, fifth dorsal vertebra tender on pressure. At autopsy, tumor found at this site, pressing on spinal cord, microscopically tumor resembled a colloid goiter, thyroid had showed no enlargement, but on careful examination, a nodule the size of a pea was found in the right lobe, resembling a thyroid adenoma.

CASE 2. Man, age 46. Compression myelitis, tumor on third dorsal vertebra, and another on first lumbar vertebra, structure that of a colloid goiter, colloid very compact. A small goiter giving no clinical symptoms with no anatomical signs of malignancy.

K. S. de Graaf³ Female, age 56. Adenocarcinoma of the thyroid, with metastases in the ninth, tenth, and eleventh dorsal vertebrae, of the same histological structure as the malignant thyroid.

M. Patel⁴ reviews 18 cases.

CASE 1. Patel's own female age 65. Hypertrophy of the thyroid gland, with no increase in 30 years, no symptoms of malignancy.

Secondary tumor at inner angle of the orbit, pulsating, microscopically of the type of the thyroid. Certain parts reproduced exactly normal thyroid tissue, while other parts had the character of a highly malignant epithelioma. Operation, but return of the growth in a year.

CASE 2. Honsell Female, age 20 years, in February, 1896, operated on for goiter of the colloid type apparently benign. In November, 1898, the part of the thyroid gland left at the first operation had increased very little in size without causing pain or other symptoms. Small tumor on frontal bone, non-pulsating, removed, resembled histologically a colloid goiter without signs of malignancy.

CASE 3. Cohnheim (see bibliography) Female

¹ Zur Kenntnis der Knochenmetastasen bei Schilddrüsenentzündungen. Mittheilung von Wechsung 1900. Jähr 1433.

² Ueber Knochenmetastasen mit Schilddrüsenleiden. Arch f. path. Anat. 1900. clxx 464.

³ Ueber Strumen mit Knochenmetastasen. Mittheilung an d. Genußgeb. d. Med. u. Chir. 1905. 21. 815.

⁴ Tumours. Lésions du corps thyroïde donnant des métastases. Rev. d. Chir. 1904. clxx 308.

age 35, at autopsy both lobes of the thyroid gland hypertrophied the left lobe showed type of the colloid goiter, the thyroid showed nothing else abnormal except in the median portion a small nodule, which penetrated into the veins. Similar nodules, showing typical thyroid structure were found in the second, third, and fourth lumbar vertebrae and in the right femur.

CASE 4. Von Eiselsberg (see bibliography). Man, 37 years old, had a goiter since the age of 21; during four years a tumor had developed between the two parietal bones, microscopic diagnosis showed structure typical of thyroid adenoma. Recurrence in 4 years. No increase in size of goiter.

CASE 5. Kraske (quoted from von Eiselsberg). Woman, age 53, tumor of frontal bone, solid and indolent, structure analogous to that of the thyroid gland.

CASE 6. Riedel (quoted from von Eiselsberg). Female, age 40. Tumor of inferior maxilla with structure like that of the thyroid gland. Removed, recurrence in ten years. No visible enlargement of the thyroid.

CASE 7. Feurer⁵ Female, age 68 years, a small goiter, after a blow a tumor developed on the left parietal bone, penetrating the skull, diagnosed as sarcoma. Tumor partially removed, recurrence and death ten months later. Examination showed that both the thyroid and the bone tumor were composed of typical colloid goiter tissue.

CASE 8. Riedel (same reference). Female, large goiter, a tumor developed on the lower jaw, removed, no recurrence in 4 years.

CASE 9. Gussenbauer (same reference). Female, large benign goiter. Paraplegia of the legs, and general pain. Tumor located on the right side of the tenth and eleventh thoracic vertebrae, removed, recurrence. Microscopical examination showed typical adenoma of the thyroid gland.

CASE 10. Middeldorff (see bibliography). Female, age 56, a small movable goiter, no symptoms of malignancy. Tumor at the nape of the neck, not pulsating diagnosed as sarcoma. Removed and found to have structure of a thyroid adenoma. Other bone metastases developed, as shown at autopsy, tumor in the occiput recurred, similar tumors with the same structure found in the lumbar vertebrae, the sacrum, the pelvic bones, and the upper part of the humerus and femur. No change in the goiter found.

CASE 11. Jaeger (see bibliography). Female, age 60, goiter for ten years. On examination, tumors found involving the sixth and seventh cervical and the first dorsal vertebrae, a second tumor in the third and fourth lumbar vertebrae, patient stated these had developed after a fall. Second tumor removed, structure that of thyroid adenoma.

CASE 12. Goebel (see bibliography). Female, age 54. Goiter of moderate size. Tumor in the femur, removed, femur disarticulated. Microscopical structure of benign goiter.

⁵ Festschrift für Kocher 1897. p. 275.

CASE 13. Mamm. Female age 41; garter for 10 years. After a blow, a tumor developed near the right iliac bone, removed. Structure that of colloid cancer.

CASE 14. Von Haslberg (see Bibliography). Man age 60, thyroid gland slightly enlarged after a blow tumor formed on the sternum. Tumor removed. Autopsy showed colloid cancer, the metastatic tumor composed of vascular tumor with cystic cellular formation, the author states that it was an adenocarcinoma.

CASE 15. Von Haslberg. Man age 41. He is garter, on a stage showing a few metastatic nodules in the thyroid at the base of the skull a tumor found invading the system of the vertebral column a thyroid adenocarcinoma.

CASE 16. Author's Case. A central growth in the thyroid malignant thyroid metastases in the vertebrae, the ribs, and the iliac bone.

CASE 17. Litten's Case of adenocarcinoma of the thyroid metastases in vertebrae, ribs, and iliac bone.

CASE 18. Hill's Case (Bibliography). Man age 45. Paraplegia and other spinal symptoms. At autopsy no enlargement of the thyroid gland, but tumor found in the skull and in the 11th dorsal vertebra causing degeneration of the spinal cord. Section consisted of thyroid tissue, but showed epithelial proliferation suggesting malignancy.

DeBarny, 1906 (for exact reference see general bibliography). Female age 35. A garter of the simple type. No symptoms of malignancy removed 6 years previous. Pain with progressive wasting gradually paralysis and loss of reflexes in the extremities indicated spinal disease. At autopsy tumor found in several of the ribs on both sides and in the fourth and fifth vertebrae of vertebrae only the larger of which was examined, it was especially proved to be a spread of nodule of thyroid tissue.

P. Hallstrom's Female age 64. With small pulsating garter and symptoms of adenomatous plus a pulsating tumor on the sternum diagnosed as an adenoma of the aorta. At autopsy the garter appeared histologically to be of the typical benign colloid type. The lower tumor consisted of thyroid tissue with irregular epithelial proliferation typical of cancer.

P. Linmarch.

CASE 1. Male age 61. Autopsy showed malignant garter with metastases in the iliac bone, sternum and vertebrae. He had no tumors removed mostly of normal thyroid tissue.

CASE 2. Female age 60. Paraplegia. Autopsy showed malignant garter metastases in the first dorsal vertebra with histological structure the same as the thyroid growth.

Reddy, 1907 (for exact reference see general bibliography). Male, age 64. Clinical diagnosis

1. Aorta aneurysm.

2. Basal Eosinophilia.

3. Cancer thyroid gland.

4. Cancer thyroid gland.

5. Cancer of aorta. Large mass of tissue removed from the upper jaw. Microscopic examination showed it to be histologically a thyroid adenoma. Tumor removed and grew after operation, causing death. No hypertrophy of the thyroid gland found either before or after the operation.

T. Linmarch.

CASE 3. Male age 60. Had a garter with symptoms indicating malignancy removed some months previous. Histological examination did not show malignant growth. The bone tumor was on the occipital bone. No operation.

CASE 4. Patient age 35, operated on for cancer, removed at pulsating garter in July, 1910. In February, 1911, a tumor found on the right clavicle. Histological examination not made.

CASE 5. Male, age 35, operated on for garter on November 21, 1901, diagnosed "pulsating garter." On November 17, operation for a bone metastasis on the left side of the head on the frontal and parietal bones. Histological structure not given.

Jalavsky's Female age 25. Had a small garter without clinical symptoms. A pulsating tumor of the right lobe of the thyroid gland. At autopsy showed that the tumor consisted of typical thyroid tissue. Removal of diseased part, good results.

Jalavsky's Male age 65. Patient had a garter which had been treated in several cases of symptoms for 10 years. But had grown rapidly for five years. A few years before its appearance at the hospital. Tumor on the clavicle near sternoclavicular joint. Garter appeared clinically benign to the marked increase in size and also in the metastases. But tumors removed with apparent success.

P. Parker's Female age 65. Pulsating garter in the upper part of the sternum diagnosed as an aneurysm followed a fall. At autopsy the tumor was found to be composed of epithelial cells and some thyroid tissue externally the colloid, the thyroid gland was also infiltrated with epithelial cells.

Mignot and Huet's Male age 65, tumor of the dorsolumbar segment of the spinal column had existed about 14 years. Removed. It recurred in about 5 months, ending in death. Examination of the tumor showed it to be composed largely of normal thyroid tissue, but in some portions there were cells suggesting an epithelioma. Examination of the thyroid showed a small central epithelioma the size of a hernia in the left lobe of the thyroid.

H. Marx, Huet and P. Buznet's One case, female

1. Zur Histologie der Thyreoiden. In: Verhandlungen der 3. Sitzung der Deutschen Naturforscherversammlung, 1904, p. 101.

2. Die Thyreoiden. In: Die Krankheiten der Thyreoiden. Leipzig, 1904, p. 101.

3. Die Thyreoiden. In: Die Krankheiten der Thyreoiden. Leipzig, 1904, p. 101.

4. Die Thyreoiden. In: Die Krankheiten der Thyreoiden. Leipzig, 1904, p. 101.

5. Die Thyreoiden. In: Die Krankheiten der Thyreoiden. Leipzig, 1904, p. 101.

6. Die Thyreoiden. In: Die Krankheiten der Thyreoiden. Leipzig, 1904, p. 101.

age 23; tumor of upper end of right humerus, appearing clinically like a sarcoma, pulsating. Microscopically thyroid tissue. Patient had a goiter, clinically benign, that was not removed. Operation of resection performed, no local recidivation, but multiple bone metastases caused death.

Regensburg, 1912 (for exact reference see general bibliography). One case, a female aged 55, had a slight enlargement of the thyroid, tumor in the upper arm, which clinically resembled a sarcoma, but on microscopical examination proved to be typical thyroid tissue. Arm amputated with apparent success.

BIBLIOGRAPHY

CASE REPORTS

Cases reviewed by Patel, 1904

- CORNHEIM, J. Einfacher Garterkropf mit Metastasen. Virchow's Arch f path Anat, etc, Berl, 1876, lxviii, 547.
 EISELSBERG, A. von Ueber Knochenmetastasen des Schilddrüsenkrebses. Verhandl d deutsch Gesellsch f Chir, 1893, xxii, 255, also in Arch f klin Chir, 1893, xli, 430.
 GOERTEL, C. Ueber eine Geschwulst von schilddrüsenartiger Bau im Femur. Deutsche Ztschr f Chir, 1898, xlvii, 348.
 HOLLIS, W. A. Case of paraplegia with multiple thyroid tumors. Lancet, Lond, 1903, i, 884.
 HONSELL, B. Ueber gutartige metastasirende Struma. Beitr z klin Chir, 1899, xxiv, 112.
 JACOB, R. Ueber Strumametastasen. Beitr z klin Chir, 1897, xli, 493.
 MIMMELDORFF, K. Zur Kenntniss der Knochenmetastasen bei Schilddrüsentumoren. Arch f klin Chir, 1894, xlviii, 507.

Cases not reviewed in this report

- COATS, J. Case of simple diffuse goiter, with secondary tumor of the same structure in the bones of the skull. Path Soc Tr, 1887, xxxviii, 399.
 FLATEAU, E. and KOELICHEN, J. Carcinoma ossa frontalis, parietalis et cerebelli bei einem 17 jährigen Maedchen, als Metastase eines Adenome colloides glandulae thyroideae. Deutsche Ztschr f Nervenh, 1906, xxxi, 777.
 HAWARD, J. W. Case of bronchocele with secondary growths in bones and viscera. Path Soc Tr, 1882, xxxiii, 291.
 HELBERG, C. Demonstration eines Präparates von metastasirendem Kropf. Berl Klin, 1901, xxviii, 377.
 HITCHCOCKSON, J. Bronchocele with malignant growths in bone. Archives Surg 1895.

- LEDWARD, H. A. Carcinoma of thyroid, metastases in calvaria. Tr Path Soc, Lond, 1903, lv, 60.
 MORRIS, H. Pulsating tumors of the left parietal bone. Tr Path Soc Lond, xxx, 259.
 PORALI. Note sur un cas de goitre metastatique. Clin chir, 1909, xvii, No 1.
 VALLERIAN. Sarcoma pubatile multiple de la fosse temporale gauche, du corps thyroide, et du sternum. Progrès med, 1875, iii, 73.

GENERAL

- BETLEY, G. E. Affections of the thyroid gland. Albany M Ann, 1907, xxviii, 92.
 BLUMER, G. Clinical manifestations of tumor metastases in the bones. Yale M J, 1917, xviii, 153.
 CATHCART, C. W. Essential similarity of innocent and malignant tumors. 1907.
 DERCUM, F. X. Thyroid metastases to the spine. J. Nerv & Ment Dis, 1906, xxxiii, 153.
 DEVIC and BERIEL. Les goitres metastatiques sans goitre. Arch prov d chir, 1906, xv, 640.
 DOCK, G. Diseases of the thyroid gland. Osler's Modern Medicine, 1909, vi, 377.
 HERTZLER, A. E. Treatise on tumors. 1912.
 HOGGEND, B. Kasuistisches und Kritisches zur Lehre des Karzinoms der Schilddrüse. Deutsche Ztschr, f klin Chir, 1904, lxxiii, 104.
 KOCHER, A. Diseases of the thyroid gland. Keen's Surgery, 1908, iii, 336.
 LIMACHER, F. Ueber Blutgefassenendotheliome der Struma mit einem Anhang ueber Knochenmetastasen bei Struma Maligna. Arch f path Anat, 1898, cli, Supp, p 113.
 MULLER, G. P. and SPEER, J. Malignant disease of the thyroid. Univ Penn M Bull, 1906, xix, 74.
 OCHSNER, A. J. and THOMPSON, R. L. Surgery and Pathology of Thyroid and Parathyroid Glands. 1910.
 POSER, O. A. Ueber Metastasenbildung gutartiger Kropfe. 1906.
 REGENSBURGER, F. Schilddrüsenmetastasen im Knochen. Berl klin Wchnschr, 1912, Aug 12.
 ROCHER, H. Des metastases du goitre. 1903.
 SCHMIDT, R. Zur Kasuistik und Statistik der Knochen-tumoren (Clavicula) mit Schilddrüsenbau. 1906.
 SHEPHERD, F. J. Surgical diseases and wounds of the thyroid and thymus. Bryant and Buck, American Practice of Surgery, vi, 353.
 SIMMONS, C. C. Tumors originating in bone. Bryant and Buck, American Practice of Surgery, 1907, ii, 394.
 SUTTON, J. B. Tumors—Innocent and Malignant. 1911.
 WELLS, H. G. Mixed malignant tumors of the thyroid. J Path & Bacteriol, 1907, vii, 357.
 WELLS, H. G. Thyroid. Buck's Reference Handbook of the Medical Sciences. 1904, vii, 777.

POST-OPERATIVE ILEUS¹

By WILLIAM M. THOMPSON, M.D., F.A.C.S., CHICAGO

OTHERS may have had the dreaded specter of this serious post-operative disease facing them after operating for appendicitis, abscess, or some other pelvic infection, with adhesions, and have groped through the literature for some light as I have done.

The publication of any experience, either practical or experimental, that in any way illuminates this subject is amply justified by a study of statistics of post-operative obstruction. For example, Deaver and Ross (1) report 276 cases with a mortality of 42 per cent. W. H. Coley (2) says that the deaths are from 10 per cent for those operated upon within the first twenty-four hours, to 50 per cent for those operated upon within seventy-two hours. Naunyn (3) studied 288 cases, with 75 per cent recoveries for those operated upon within 48 hours, and only 35 to 40 per cent for those operated upon on the third day. Fischer (4) reports 40 cases with a mortality of 52½ per cent. Ruge (5) reports a mortality in obstruction following appendiceal abscess of 50 per cent in early obstruction, of 45.8 per cent in late obstruction. Forty-four cases are reported. John Young Brown (6) reports 59 cases operated on early, with a mortality of 20 per cent. He says that delayed operation causes a high mortality. W. C. G. Kirchner (7), in a study of 70 cases, of which 10 were post-operative adhesions for which resection was done, reports a mortality of 50 per cent.

J. B. Murphy (8) says that the causes of adynamic ileus are (1) muscular paralysis from trauma or exposure, (2) local traumatic peritonitis, (3) local or general septic peritonitis, (4) embolism of mesenteric vessels, (5) phlebitis, (6) strangulation of pedicles by ligatures.

To determine the causes of this high mortality there has been considerable experimental work done and more speculation based upon the clinical picture. I refer to the experimental work of Hartwell and Hogue (10),

of J. W. Draper (11); of Whipple, Stone and Bernheim (12); of McLean and Andrus (13), of Lynch and Draper (14), of Fred J. Murphy, and Barney Brooks (15). Among those who have made autopsy studies are B. F. Davis (17) of Chicago. The experiments of Fred Murphy and Brooks represent to a large extent the results of so many other workers that I shall cite their conclusions.

1 In intestinal obstruction the contents of the obstructed bowel contains a toxin which is absorbed in sufficient amount as to produce definite symptoms of pathological lesions and death.

2 Toxins are the result of bacterial growth. They are not specific from any part of the intestinal tract and may be found in the gall bladder.

3 The chemical and physical characteristics of the toxic substance may vary with the length of time which the obstruction has existed as well as with the different conditions under which the obstruction occurs.

4 This toxin may enter the circulation by way of the thoracic duct.

5 Death is the result of a toxemia which may be independent of the infection of the peritoneal cavity or general circulation.

6 The toxic substance does not pass through the normal mucous membrane.

7 In the production of symptoms the factors which make absorption possible are more important than the factors which produce the toxin.

8 Interference with the circulation of the obstructed intestine is the essential factor in allowing abnormal absorption.

9 Simple obstruction of a segment of duodenum or jejunum results in earlier and severer symptoms than similar obstruction of a segment of ileum because the secretion in the lumen of the former leads to rapid distention and circulatory disturbance of the bowel-wall.

10 Symptoms and pathological lesions

¹ Read before the Chicago Gynecological Society, January 21, 1916. (See discussion p. 46.)

following the intravenous administration of the contents of a segment of bowel are the same as those described from intravenous injection of certain ptomaine poisons

11. In the surgical treatment of cases of intestinal obstruction that part of the intestine with a mucous membrane which has been so damaged as to permit of abnormal absorption should be resected rather than drained

McLean (16) states that as a result of his dog experiments death was due to lowered blood pressure. Others say that conditions that produce death are similar to *hæmorrhage*. Overall (18) states that death is due first to secondary peritonitis, second, to splanchnic paresis; third, to absorption of poisonous products

Braens' (19) experiments show that the absorption from ileus is very slow when the dog can be kept alive for a long time by saline transfusion

After hearing of these different results one is attempted to ask if absorption is so great, how can there be any dehydration. On the other hand, if the bowel dehydrates so rapidly, how can it absorb sufficient toxins to produce death. However, this is not the *verus probandi* of our argument

We have shown this grave surgical disease has a high operative mortality in the hands of the ablest surgeons. An analysis of the methods of treating and operating for the disease will show that the mortality is due to a lack of surgical progress in this field as compared with other departments of surgery. In addition to the timidity and reluctance often manifested in attacking these conditions, owing to our inability to make an accurate diagnosis between general peritonitis and local peritonitis, or as to whether ileus is adynamic or merely mechanical obstruction, postponement of diagnosis, prolonged treatment until ballooning of the intestine (Wahls sign), passing into general tympanites, and finally the vascular changes begun to show which greatly enhance the gravity of the condition

Undoubtedly as Handley (20) and others have pointed out, our knowledge of the pathology of ileus has been gained in the

autopsy room more often than the operating room. Thus the confusion of ideas as to its origin and progress with the post-mortem studies

We have passed in a brief résumé the causes of ileus. Let us sum up the clinical signs with the three words: vomiting, peritonitis, and obstruction

The clinical picture of ileus is represented by a patient with the above signs two to three days subsequent to operation for pyosalpinx and adhesions, or pelvic appendicitis, or any pelvic abscess walled off by adhesions. The tenderness is confined to the lower abdomen and to the right, if it be appendiceal. The rigidity is slight and confined to the lower abdomen. There is still respiratory motion in the upper abdomen. The pulse is not as wavering nor the temperature as high as in general peritonitis. In the abdomen that part of the ileum above the true pelvis is distended with gas, still farther up fluids take the place of gas. The pelvic ileum is flattened, congested, and covered with a flaky fluid, over which, as a guard against the encroaching pelvic peritonitis, lies omentum, tangled and adherent. Distention precedes peritonitis. The fires of peritonitis fanned by enemata, cathartics, and other efforts to produce peristalsis, break through the omental and fibrin barriers, and once out of the pelvis rapidly overtake the distention, and the patient is moribund

It should be borne in mind that while in the above description peritonitis ended in obstruction, the converse is true of obstruction which may end in peritonitis

The first suggestions for the treatment of ileus that proved at all satisfactory were made by Louis (21) in 1757, and enterostomy was successfully performed by Renault in 1787. Nelaton revived the operation in 1840, and gave it the stamp of orthodoxy, and so on down to the present it remains the sheet anchor with such additions and modifications as circumstances seem to suggest.

To quote from later writers, Fred Murphy advises that the intestine in patients in whom the mucous membrane is destroyed should be resected rather than drained. Tennant (22) advises enterostomy and drainage, and warns

as to the penalty from bowel resection as a greater hazard for the patient. Andrus (23) recommends enterostomy, followed later by anastomosis to close the intestinal wound, and says it is rarely necessary to free from adhesions. Ford (24) recommends enterostomy and drainage. Reynolds (25) advises enterostomy. Graham (26) favors enterostomy and if the bowel is badly damaged, resection. A Webb Jones (27) advises drainage of the bowel with irrigation, and later resection and anastomosis. Levings (28) recommends enterostomy and afterward removal of the adhesions. McEwin (26) says the treatment should be ileostomy and hypodermoclysis or proctoclysis. Alexius McGilnann (29), of Baltimore, advocates enterostomy to relieve the body of material that is the source of toxemia and hypodermoclysis. Johnston (30) recommends enterostomy or resection, with irrigation of the upper and lower loop of intestine. Behan (31) says surgical intervention is of doubtful value.

In the *Medical Press and Circular*, London, May, 5, 1915, there appeared an abstract of the Hunterian Lecture on "Ileus Duplex" by Simpson Handley. The report of the entire lecture was published in the *British Journal of Surgery*, for October.

Dr. Kenny and myself working together in the winter and spring of 1914 and 1915 had reached the same conclusions with the exception that we found ileocolic anastomosis to be superior to the ileocecal and we believed that if the competency of the ileocecal valve is of any value in the function of the intestine, any short circuiting that preserves this function would prove more satisfactory than ileocolostomy.

As we consider that Simpson Handley's work is the most consistent advance that has been made in the treatment of ileus, I will mention the principal points of his method: (1) Ileocecal anastomosis for ileus due to adhesions or some other cause than peritonitis. (2) Ileocecal anastomosis and cecostomy for inflammatory ileus or ileus duplex.

He divides the obstruction into three stages: (a) Obstruction of the ileum alone, (b) obstruction of the ileum with parietis of

colon; (c) complete obstruction of colon and ileum.

He reports thirteen cases treated by different methods, and all three cases operated by ileocolostomy with cecostomy recovered. Only three of the ten cases operated on by other methods recovered. His explanation of the cause of obstruction of the pelvic colon is that peritonitis or pelvic inflammation involves the pelvic colon just as it does the ileus only more slowly.

My cases of ileus with obstruction of the pelvic colon have all been women in whom salpingectomy has been done in addition to appendectomy, and I attributed the obstruction of the pelvic colon to traction on the ligamentum infundibulocolicum and ligamentum infundibulopelvicum, which are simply folds of peritoneum running back from the uterus and broad ligaments and forming the mesosigmoid. If a section is taken out of these ligaments and the ends pulled upon, after doing left sided pyosalpinx and completing the peritoneal toilet, it is easily possible to kink the sigmoid. Add to this the absorption from the septic pelvis and traction, and inhibition of the blood supply of the mesosigmoid would result. Of course it goes without saying that the bowel peeled off an ovarian abscess is very apt to become paralyzed.

During the fall and winter of 1914 and 1915 we had operated on four cases of obstruction by short circuiting methods and drainage. Three were cases of obstruction due to adhesions were short circuited, and recovered. One was an acute post operative ileus with fecal distention. Enterostomy was done, and later ileocolic anastomosis. The result, recovery. The fistula healed spontaneously.

We decided to run a series of experiments on dogs to ascertain what was the best method of short circuiting and as far as we were able to tell how much damage the bowel would stand and recover if put to rest by short circuiting. A number of methods were tried before we finally settled upon the technique which was as follows:

(1) Make an incision in the abdomen for the short circuiting above and to the side of the laparotomy incision. (2) Handle in-

testine gently and as little as possible. (3) Keep away from the adhesions Ileus is caused by the breaking up of adhesions in the presence of pus (4) Avoid pulling on the mesentery. (5) Make a lateral anastomosis, if possible, between healthy ileum above and ileum just proximal to the ileocaecal valve, as this portion is seldom involved in ileus (6) Do an appendicostomy or caecostomy to allow for drainage and for the introduction of fluids into the system

The first attempt to produce ileus on a female dog was by clamping and bruising the lower ileum Six days later the mesentery to which this portion, six inches of gut, was attached was ligated and severed from the gut Ten days later the dog was very sick Lateral ileocaecal anastomosis was done Post mortem six weeks later showed a specimen somewhat damaged due to infection of the abdominal wound, otherwise the result was good.

In the second dog the mesentery was ligated and cut away and the peritoneum stripped off for six inches from the same part of the ileum from which the mesentery was severed Three days later the stripped bowel was linked by sewing the muscularis to the muscular coat laterally Nine days later the dog was very sick and emaciated Ileocolic anastomosis was done A post-mortem six weeks later showed perfect anastomosis with some adhesions and the remains of an old peritonitis

In the fourth dog, a large female, ileus was produced in the following manner The intestines were stripped of peritoneum for the space of six inches and punctured wounds made by perforating the intestine with needles Two days later the mesentery was stripped along the side of the intestine and a sponge packing inserted between the mesentery and some coils of the intestine Three days after this a lateral ileo-ileal anastomosis was done, and the dog made a good recovery Six weeks later at the post-mortem the anastomosis showed some adhesions The damaged gut has apparently a normal appearance, and there is no peritonitis

The next dog to go successfully through the procedure was a large male The small

intestine was ligated in two places about two inches apart and about six inches above the large intestine with silk ligatures Three days later the dog was vomiting and seemed very weak and emaciated Ileocolic anastomosis was done Six weeks afterward post-mortem showed no peritonitis The anastomosis was perfect. The evidences of back pressure in the caecum and appendix are well shown The injured gut was normal in appearance

Of course, in these cases it was not possible to do a caecostomy to relieve the above-mentioned back pressure

The following case so well illustrates inflammatory ileus with the complications, that I report it

Patient, Mrs H G, aged 21, married two years, two years ago had double pyosalpinx Both tubes and the right ovary were removed Patient complained of a purulent vaginal discharge, constant pelvic and abdominal pain, and inability to move the bowels without using cathartics and enemata, nausea, and vomiting

March 18, 1915, laparotomy Large abscess the size of an orange in the left ovary The pelvic colon, sigmoid, and pelvic ileum were adherent to the abscess The bowel was stripped from the mass and released pus poured over the intestines Left ovariectomy, high amputation of the uterus, and appendectomy completed the operation The abdomen was closed with a drain in the pelvis She was returned from the operating room in good condition On regaining consciousness, she began vomiting, and in spite of eserine, gastric lavage, enemata, and what not she vomited always clear fluid or fluid mixed with bile No flatus was passed On the second morning her pulse was 163, feeble, temperature 99.8° Her pinched features and hollow eyes showed the effects of dehydration and toxæmia The stitches were removed, and an enterostomy done and a tube sewed into the bowel for drainage Twenty four hours afterward a faecal fistula appeared in the pelvic colon, and another in the pelvic ileum

She rallied slowly Fluids were given intravenously, subcutaneously, and per rectum, and gradually the convalescence became less stormy.

On April 15, a high incision was made in the abdomen clear of the old wound region, the enterostomy wound closed, and an ileo-ileal anastomosis done, as previously described In two weeks the fistula closed and the patient was discharged cured the last of May

Two months later, when on a fishing trip in Wisconsin, she had an attack of abdominal pain, vomiting and purging She said she vomited and passed castor oil, and could not imagine where it came

from as she had taken none since leaving the hospital. Had the oil remained in the short curved segment since it was given her after the first operation, and had the paralyzed gut resumed its function? I believe it had. The radiographs taken lately show that the whole intestine is active.

CONCLUSIONS

1. We believe that the best results are obtained in the treatment of inflammatory deus by enterostomy and drainage in cases that are so ill that radical measures would be fatal. Enterostomy should be done rapidly and without disturbing the adhesions. When the patient recovers, ideal anastomotic closure of the enterostomy wound and excision or appendectomy will complete the cure.

2. In favorable cases ideal anastomosis with excision or appendectomy for drainage and to relieve the back pressure in the colon gives the best results.

3. That by short circuiting and putting the damaged gut at rest it may be restored to health and function even after vascular changes have taken place.

4. That the mortality of resection for this disease is too high to give it a place in the treatment of inflammatory deus.

5. That the adhesions should not be broken up or the damaged gut handled in the operation.

BIBLIOGRAPHY

1. Decker and Egan. *Ann. Surg.*, Phila., 1915, Feb.
2. Coffey, W. B. *Keen's Surgery*, 17, p. 30.
3. Nathan. *Keen's Surgery*, 16, p. 645.
4. *Practical Med. News*, 1922.
5. Fisher. *Arch. Int. Med.*, 1917, Nov., 211.
6. Rosen, John Henry. *Surg., Gynec. & Obst.*, 1917, 1, 4, 47.
7. Knicker, W. C. G. *Tr. Am. Ass. of Surg. & Gynec.*, 1914.
8. Fisher, J. A. *Surg., Gynec. & Obst.*, 1914, Nov., 4, 1.
9. McNeill, J. I. *Keen's Surg.*, 16, p. 792.
10. Hartwell and Hester. *Am. J. M. Sc.*, 1914, March.
11. Decker, J. W. *J. Am. M. Ass.*, 1917, Oct. 25, 1145.
12. Wessinger, St. George, and Richardson. *J. Exp. Med.*, 1916, 27, 477.
13. McLean and Ayres. *J. Am. M. Ass.*, 1917, 1, 1914.
14. Fisher and Decker. *Am. J. M. Sc.*, 1916, Feb., 24, 413.
15. McNeill and Parker. *Arch. Int. Med.*, 1913, 1, 3, 323.
16. McLean, A. *Ann. Surg.*, Phila., 1916, Oct., 437.
17. Hirsch, J. J. *Tr. Chicago Med. Soc.*, 1917.
18. Fitzgerald, H. C. *J. Iowa M. Med. Soc.*, 1915, v. 10.
19. Lister, Thomas. *Br. J. Ch.*, 1904, 1, 311.
20. Rosen, J. W. *Surgery*. Med. Press & Co., 1915, May 7, 1st J. N., 1915, Oct.
21. Lister. *Short Practical Surgery*, p. 763.
22. Tammann, C. F. *Br. J. Med.*, 1915, 2, 2.
23. Ayres, K. C. *J. Mich. M. Med. Soc.*, 1917, 2, 15.
24. Fisher, J. M. *Wisc. Med. Rec.*, 1915, 21, 97.
25. Fisher and J. W. *Keen's Surg.*, 1914, 10.
26. Graham, J. *South M. J.*, 1, 191.
27. Jones, A. Wren. *Lancet*, Lond., 1916, March 11, 113.
28. Lister, A. H. *Am. J. Surg.*, 1917, Nov.
29. McNeill and Ayres. *J. Am. M. Ass.*, 1917, 1, 231, 11, 1917, 11, 171.
30. Johnson, J. C. *Med. Rec.*, 1917, Jan. 2.
31. Fisher, J. *Internat. M. J.*, 1914, 2, 1.

THE OLD ART AND THE NEW SCIENCE OF SURGERY¹

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ART is the application of means and methods to accomplish desired ends. Science is the systematized knowledge of principles and laws. Surgical art is old. Surgical science is new.

The most primitive surgery included all the rudiments of an art. The papyrus of Ebers from the excavations of Memphis records the application of principles and rules in surgical performances. Mummies of Luxor and Karnak of the date of 5000 B. C. and antedating the advent of Adam several centuries show evidence of the practice of surgical art, as they have gold-filled teeth.² The art was taught at Thrace and Babylon, at Hehopolis, and hundred gated Thebes. Its history parallels the history of man.

Empirical asepasis was practiced by the pupils of Susruta, a Sanskrit writer of 1000 B. C. He³ advised his students to keep their hair and nails short and to wear white linen coats.

At the time of the destruction of Pompeii, surgical handicraft, as evidenced by hundreds of almost incredibly modern-looking instruments and contrivances in the Naples museum, was becoming complex through the grouping of many mechanical ideas, though it cannot be said to have reached the stage of systematic science. If we could remove the rust and verdigris from these ancient appliances in the Bourbon museum and plate them with nickel, we should have before us an exhibition which we would find to be in many respects surprisingly and interestingly modern. Many of these devices should bear, if common impressions of priority are correct, the names of living surgeons. Here are many evidences that surgeons of hazy antiquity appropriated without credit the inventions of the moderns. For example, one may view here the trivalve rectal speculum to which we are accustomed to attach the name of a beloved Nestor of American proctology, as well as modern stone and bullet forceps and

trephines with rotary bit-stock handles. The later works of Guillemeau depict an instrument strikingly similar to a modern bone-holding clamp for plating operations.

Throughout nearly all of historic time surgical knowledge was purely empiric. It was art, not science. So it was with the Egyptians, the Babylonians, and the Lusitanians,⁴ who exposed their sick in public so that if passers-by had been similarly attacked they might give advice to the sufferers.

It is said that a quasi science of surgery was born in Greece; that neither in Egypt, nor in India, nor in Palestine, nor in Persia but in Greece alone were planted the earliest seeds of scientific culture. "There one must seek the most perfect blooms of human knowledge which in every fortunate land unfolded and bore most precious fruit" (Kurt Sprengel).

Thus Hypocrates, son of Heraclides, descendant of Aesculapius and Apollo, is said to have raised surgery from a system of superstitious rites practiced wholly by the priests to the dignity of a learned profession. It is probably true that he enriched surgery with principles and truths. In every wound he recommended nothing so imperatively as elevated position of the member as well as a cautious diet. He taught the value of heat in treating wounds and in applying splints to fractures, advised that they be adjusted loosely without compression, thus revealing an early familiarity with the specter of Volkmann's paralysis. This was not surgical science, rather it represented an "undigested collection of experimental notions vaguely described, disfigured by tradition and often rendered inutile by superstition and ignorance."

Scientific surgery according to the modern concept, that is, "formulated knowledge of surgical principles and surgical laws, based on biologic facts," may be said to have come into existence during the last century with the birth of the school of physiologic medicine.

¹Gorton. History of Medicine.²Heller. The Lancet Lond. 1910 January 8.⁴Park. Epitome of Medical History.¹Address of President of the Western Surgical Association, Des Moines, Iowa, December 17 and 18, 1913.

founded by Broussais, Bichat, Roser of Stuttgart, and Wunderlich, who called pathology the physiology of the sick, and the advent of cellular pathology, with the associated new development of the ancillary surgical sciences, as physiology and bacteriology; when Virchow, casting away the vagaries of Paracelsus "arranged in better form than had hitherto been done, a view of the cellular nature of all vital processes, both physiologic and pathologic, animal and vegetable, so as distinctly to set forth what even the people had long been dimly conscious of, namely, the unity of life in all organized beings, in opposition to the one-sided humoral and neuristical (solidistic) tendencies which had been transmitted from the mythical days of antiquity and at the same time to contrast with the equally one-sided interpretations of a grossly mechanical and chemical bias—the more delicate mechanism and chemistry of the cell."

About the same time Pasteur demonstrated that fermentation and putrefaction are caused not by chemical forms as Liebig had taught but simply by the agency of lower organisms.

Thus the pure sciences of cellular pathology and bacteriology of Virchow and Pasteur established and explained causes, principles and laws which joined with the older applied science or art of surgery with its knowledge of phenomena and facts and supported by all the rapidly evolving tributary sciences having to do with the origin, structure, development, and function of living things brought forth the newer group science or compound science of surgery.

We think of Morgagni, Magendie, Bernard, Recklinghausen, Rokitsansky, Lister, and Johannes Mueller, and others of their type and generation as among the founders of the modern research science of surgery. Concerning the great surgical architects and artists as well as the philosophers of this important period, it is to be said that however much we may admire their ingenuity in invention or their virtuosity in technical performances, or their fine skill in spinning theories, we cannot catalogue them among the fathers of present-day surgical science along with Virchow and Pasteur and their sympathetic contemporaries. Thus, Lawson Tait,

renowned in the annals of surgical art, cannot, if we recall his polemic to Saenger declaring bacteria to be the products of disease, be grouped with Langenbeck and Billroth, surgical scientists who were "as expert with the microscope as with the knife and equally great with both."

The modern composite science of surgery has evolved chiefly in all the laboratories of its separate component and ancillary sciences where surgical art was and is, alas, too often a stranger.

But let us not assume that surgical art is either subordinate or enslaved to science (Acland). The art is at once in advance of the science and behind it. Here the art is in advance because it observes and makes use of clinical facts of which the science is not yet aware, "believing with strong conviction that which can neither be proved nor ignored." There science is in advance, claiming system and order and an exactness to which the art cannot even pretend.

The relations of the art and the pure science of surgery are intimate and direct. Thus, the art follows in the lead of the science though occasionally it cannot wait for rationalization. They are intimate, though empiric art does not sacrifice life while waiting for the proofs and explanations of science. The relations are direct in the case of all those modern means of research and remedy which the science daily gives to the art in the form of laws and principles of which a score of years ago there was no conception. To the transillumination of the body, Roentgen brought the Crookes tube and made shadowgraphs of living organs theretofore inscrutable. To the exploration of dark recesses of the body, optical science brought instruments of precision, and in what were inaccessible places, science holds the torch while art performs its task. The framework of surgical art is made up of accurate data of observation and experiment.¹ About these empiric data of art, science has organized and crystallized principles and laws. Thus, the relation of the art and the science is intimate and direct; they are as the warp and woof of established surgical knowledge.

¹ Acland: *Medicine in Modern Times*.

The closest relationship exists in the realm of established and accredited fact, for as was said, the art confronted with emergencies cannot wait until science has established her conclusions and science being *formulated*, proved knowledge and brooking no uncertainties, shrinks from the assumptions of art. However, they unite inseparably upon the high plane of fact

Now, as *formerly*, there exists in some minds a doubt as to whether the art of surgery can keep abreast of the science, sustaining itself in the close relationship with the dignity and respectability which it has enjoyed in the past. It has been said that art is a finite thing and science infinite, that the art has already attained or shall soon attain finality but that the science will grow without limit

Most of us will wish to subscribe to the view of Sir William Stokes¹ who said that "since we are still young upon the earth, the progress of the art of surgery as of the other arts is as certain as that we live and move and have our being"

It was believed that surgical art had reached its last degree of perfection in Napoleon's time and so recent and worthy a surgeon as Erichson² declared that in many respects surgical art could advance no farther. He likened the art of surgery to the plastic and graphic arts. Thus, he says sculpture reached its final development 2,000 years ago and no sculptor of modern times can hope to excel the triumphs of the ancient Greek. In painting, he avers, we find the same early perfection in the work of the Italian, Flemish and Spanish schools of the 16th and 17th centuries, and as it is with these fine arts so Erichson believed it is with certain branches of human knowledge closely allied to surgery

He conceived the advance of surgery to have been due to three factors first, the improvement of technique, second, the increased precision of results, and third, the development of scientific research

As to the exactitude of performance, and as to precision of results, Erichson believed there was little chance of future progress. For the further development of scientific

research he held out more hope. He had a most gloomy outlook upon the future of surgical art, though in the future of surgical science he glimpsed a rainbow of promise. Very old surgeons might welcome the views of Erichson as a pean of satisfaction over what they and their predecessors have done, but young men will proceed unfettered by such views of finality, so often proclaimed by the oracles and so often disproved by time

Stokes pointed out that the arts of sculpture and painting are purely imitative, whereas the art of surgery is constructive, an essential difference. The "doctrine of finality," he says, "might equally well have been promulgated in the time of Homer and the view held then that poetry had reached its goal, but the production of the great epic, the sun of all ancient literature, did not interfere with the appearance of the imperishable works of Shakespeare and Dante"

Surgical art is "huge in strength and wise in works" and no less illimitable than science, for the two are integral parts of a whole and are inseparable. To look upon surgical art as a thing of finality is to view it in its narrowest sense as a mere handicraft

Sir Bland-Sutton tells us that surgeons are of two types craftsmen and biologists. "As craftsmen, there is a limit set to their advance, but in pathology and chemotherapy the field of progress is illimitable." Here a line of distinction is drawn between surgical handicraft and surgical art-science which includes investigative study and the systematic application of knowledge gained in the research laboratories

If by study of the progress of surgical art and science we seek an answer to the question of whether the art or the science is becoming increasingly the more important, we must find that more and more it is the "heaven of science which gives habits of mental accuracy and modes of thought which enlarge the mental vision, and, to use an expression of Epicharmus,³ strengthen the sinews of the understanding"

Morris and Crile designate the present as the fourth era in the development of surgery, or the era of physiology. First, in the division

¹Brit. M. J., 1886 Nov. 20

²The tendency of modern surgery. Brit. M. J. 1836 Aug. 12

³Order Equitatis and other essays

of Morris, is the heroic era of Hippocrates; second, the anatomic era of Vesalius; third, the era of pathology of Virchow, Lister and Pasteur, and fourth, the era of physiology, appropriately represented by Metchnikoff and Sir Almôth Wright. The present surgical era might with equal fitness be called the era of biology, for it is through the study of the "capabilities and the susceptibilities" and all the attributes of the normal cell complex which makes up the body, the study of the laws of life itself in all relations and of the vital processes that we will attain to that "complete truth which carries with it the antidote against the bane and danger which follow in the train of half knowledge" (Helmholtz).

Men like Crile and Carrel who go furthest, advance through the broad science of biology, which touches the problems of life at every point. Surgery must still be heroic; it must still use the synthetic and comparative considerations and the scrutiny of prognostic science of the Hippocratic era. Gross anatomy cannot be abridged. Pathology is still a great basal factor in rational surgical practice but in the fourth and highest era of Metchnikoff, Wright, and Carrel. It is the biologist surgeon, standing upon all the proved knowledge of the art and of the science as well, whose outlook on Nature and all her problems is the broadest because his viewpoint is the highest.

Cushing, a surgeon of the modern era, says that as a training ground for surgery, the anatomic dissecting room first gives way to the experimental laboratory.

Garrod, writing of biochemistry and physiology in modern research, says "We may wander among the streets of a deserted city of the past may study the fabric of its buildings—the stones, bricks, and mortar employed in their construction—and in this way may gain some knowledge of the uses for which the several buildings were designed. Just so the anatomist investigates the structure of the organs of the dead body. Once more we may tread the streets of a city of today, may watch the movements of the crowds as they pass, the gathering and the dispersal of groups of people. We may study the arrangements for the disposal of waste

products, the ways in which food supplies are brought in, dealt with, and distributed. Or we may investigate the police arrangements, the sanitary devices, and the various devices resorted to by the community for its protection. The study of the human organism on such lines is the province of physiology." We are less interested just now in the pathology of the dead than in the normal physiology of the living and abnormal physiology, or what Moynihan calls the pathology, of the living.

Recently the most valuable contributions to surgery have come from the laboratories of biology. We need no priestess upon a tripod to tell us that surgery of the future will look more and more for strength and inspiration to the vigorous sciences of biochemistry and physiology though it must continue to rest upon its original footing of normal and morbid anatomy, nor that the way to the most complete surgical development for any individual will lie not only through the "blood and sawdust" but also through the "glass and brass."

The debt of surgical art to the pure science is great and the reciprocal debt of surgical science to surgical art is hardly less. Surgical science is advancing with unexampled rapidity and no bounds can be set to its possible conquest, yet the progression of imaginative, speculative, investigative science will be more sure and steady with the support of sensible and pragmatic, empiric art upon its flank.

Sir Berkeley Moynihan¹ would have us recognize that every operation the surgeon performs in his daily vocation is an experiment from which something should be learned that every clinical observation is an addition to the sum total of human knowledge not only of the disorders of the human body but of its orderly working—not only of pathology but of physiology. In devoting attention to the individual problem he is advancing along the road that leads to more light and a clearer, wider outlook.

We do not often see a great surgical craftsman, a gifted exponent of applied surgical art, and a genius in surgical research rolled into

¹ *Brit. M. J.* 1913 July 25.

one In Billroth and Senn were combined the qualities of the great executant in surgical technique and those of the laboratory zealot. They are rare examples

Surgical art and surgical research science rarely reach their highest development in one individual and the practical and desirable alternative has been and will be to associate the genius of surgical research in one individual with the gift of surgical art in another in an harmonious working union The ideal arrangement of the future will be that which includes the establishment of special laboratories of surgical research in close association with the theaters of surgical art, and which includes the close association of both with large facilities for the study of the broader aspects of disease

Such an arrangement as this exists in many seats of medical and surgical culture in the older sections of our country and in our western territory where the group idea in medical and surgical practice has been most cultivated, are numerous instances of the close co-operation of pure surgical science with the practical art greatly to the advantage and advancement of both As an illustration, it may not be invidious to refer to a western institution which, ignoring the hazy arguments of surgical philosophy, has added so much to the more salutary surgical art-science Here refinement of operative technique vies for supremacy with the detailed study of immediate and ultimate results and thorough-going research in morbid anatomy and morbid physiology

In a comparison of important American centers of clinical surgery, a recent writer refers, with little grace but with much assurance, to western surgeons as still linger-

ing in the earliest or technical stage of development Respectfully waiving this indictment and basing our judgment on the evidence of our short past and active present, we would admonish those who cling to these older sentiments that with the unquenchable enthusiasm which impelled the early heroes of this bouyant country—"with narrow search and with inspection deep"—our seekers are keeping abreast of the most earnest and eager in the quest of the treasure trove of science

So many critics have spoken in commendation of surgery of western America that to this one who directs a patronizing allusion to the most distinguished of western clinics, we may, we hope without immodesty, commend the words of Phidias to Pericles,

You, Pericles, and I, do what we will,
Are guilty, both of us, of an offense
That envious natures never can forgive—
The great crime of success
'Tis at the tallest poppies that men strike,
'Tis at fruit bearing trees that they throw stones

From many western surgical communities of greater worth than eminence one hears less and less of things and men, and more and more of ideals Each of these helps with what light it has to dispel the darkness "It ought to be no disparagement to a star that it is not the sun"

Into the vast and attractive field of surgical scientific research all can enter and work If we labor and achieve, we shall have the best reward in the approval of conscience; the compensation otherwise is negligible If we labor and fail, we shall not have labored in vain, for "the tree sucks kindlier nurture from a soil enriched by its own fallen leaves, and man is made in heart and spirit from deciduous hopes and things that seem to perish"

REFLEX ILEUS OF RENAL ORIGIN¹

BY DANIEL N. EISENDRATH, A. B., M. D., F. A. C. S., CHICAGO

IT has been known for years that some of the surgical affections of the kidney and ureter, especially infections and calculi, may resemble acute appendicitis clinically. Another of the peculiar disguises under which lesions of the upper urinary tract may appear is that of a clinical picture resembling very closely a paralytic ileus. Distention of the intestines, at times of the stomach as well, vomiting, and almost complete obstipation obscure the pain and other symptoms of the underlying renal condition. My attention was first directed to this masking of renal conditions by the article on reflex ileus in Wilms' classical monograph on ileus. He has applied the term renal ileus or *Nierenileus* to the group of symptoms which may appear in cases of ureteral calculi or hemorrhage into tumors of the kidney or after operations on or injury to the kidney and ureter. As a rule death does not occur from such an ileus, the underlying lesion being a paralysis of the gut of nervous origin due, as Wilms believes, to a reflex irritation of the inhibitory nerve of the intestines, the splanchnic.

The symptoms of this reflex paralytic ileus are (1) meteorism, due partly to the non-absorption of intestinal gases and partly to putrefaction gases which are due to decomposition of increased gland and mucus secretions. (2) Sudden obstipation and vomiting are as important as the abdominal distention. The vomiting does not become feculent as early as in obturation ileus. Abdominal rigidity and pain may accompany the three chief symptoms just enumerated, the muscular rigidity being due to the close association of the spinal (lower seven intercostal) and sympathetic nerves.

During the past two years I have had the opportunity to study three typical cases of lesions of the upper urinary tract in which the symptoms of ileus overshadowed those of the underlying condition to such an extent that I thought it might be of service to others to direct attention to such a clinical picture.

CASE 1. Male, age 63, referred by Dr. Theodore Diller of Aurora, Illinois, with diagnosis of ureteral colic. There was a history of similar attacks for the past thirty years but he had never passed a calculus. When first seen by the writer he had the typical radiations of a right-sided ureteral colic. The abdomen was enormously distended and it was impossible to obtain the passage of either feces or flatus for over forty-eight hours. He felt nauseated constantly but did not vomit. The patient stated that with each attack of colic during recent years, symptoms of an ileus-like character had appeared. Radiograms (Fig. 1) showed the shadows of four small calculi on the left side in the course of the pelvic ureter but none on the right side, although cystoscopic examination shortly after the attack showed fragments of a stone in the bladder. The paralytic ileus symptoms subsided as soon as the pain ceased, which meant the passage of the stone into the bladder.

CASE 2. Male, age 54, seen in consultation with Dr. George McKinnock on account of symptoms resembling both an appendicitis and incipient ileus. When first examined the abdominal distention, vomiting, and inability to secure passage of feces or flatus completely overshadowed the pain in the right iliac region. The only suspicion of a renal origin of the symptoms was after the urine was examined and many red blood-cells found. A radiogram showed a fairly large calculus shadow in the region of the left kidney (Fig. 2). The intestinal symptoms subsided after three days.

CASE 3. Male, age 55, referred by Dr. A. J. Patek, of Milwaukee, with the diagnosis of gall stones made after patient had an attack of severe pain in the right hypochondrium accompanied by marked abdominal distention, vomiting, and complete obstipation. Relief from these symptoms was very gradual, the distention being still a prominent symptom when I first examined him. He had a similar attack shortly after admission to my service but as soon as the ileus-like distention and obstipation had subsided one could feel a mass in the right side of the abdomen which had greatly increased in size in the two weeks preceding his admission to my service. Several ileus-like attacks occurred during the three weeks before his death. Examination of the kidney at autopsy showed that extensive hemorrhages had taken place into a hypernephroma (Fig. 3) of the right kidney. Each recurrence of bleeding and the resultant sudden increase of intrarenal tension had resulted in an attack of reflex ileus.

I am indebted to Dr. Roy G. Pearce, Assistant Professor of Physiology of the

¹ Read before the Chicago Surgical Society, February 4, 1916. (See discussion p. 710.)

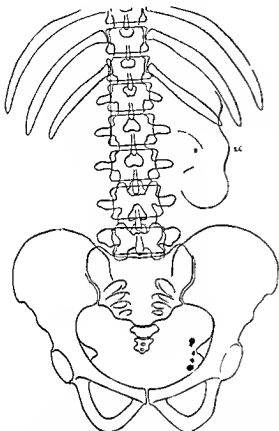


Fig 1 X-ray tracing of left kidney shadow (hydronephrosis) and calculi in left pelvic ureter. Right ureteral colic and symptoms of paralytic ileus. P, Pelvis of left hydronephrotic (LC) kidney

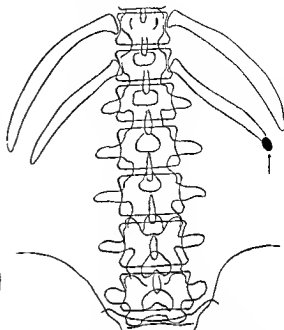


Fig 2 X-ray tracing of calculus in left lumbar ureter. Right sided pain and symptoms resembling ileus

sensory nerve fibers which are distributed to the viscera, the kidneys and ureters. The diagram (Fig 4) shows the possible distribution of these nerves to the abdominal organs in man.

Stimulation of the peripheral end of the cut splanchnic nerve in a dog, brings about an inhibition of the intestinal movements, and a decrease in the tone of the intestinal muscle. The ileocolic sphincter is, however, closed by such a manipulation. This is of especial interest since it shows the reciprocal action of inhibition of the movements of the intestines and the closure of the ileocolic valve. Adrenalin, which is secreted upon stimulation of the splanchnic, acts upon the intestines in exactly the same manner as splanchnic stimulation itself.

Reflex excitation of the splanchnic may be brought about by painful stimuli in any portion of the body. Cannon has shown that severe sensory stimulation will reflexly inhibit the intestinal movements and that this inhibition is aided by the increased secretion of adrenalin which accompanies splanchnic excitation. That the splanchnics are reflexly

University of Illinois, for the following theories as to the cause of this reflex renal ileus.

It is impossible to explain fully the mechanism involved in the production of the ileus which has been described, since we possess an incomplete knowledge of the reflex control of the intestinal movements. The musculature of the intestine like that of the heart is autonomic and contracts without the aid of the central nervous system. The peristaltic movements continue after the removal of the intestines from the body, and are doubtless due to a peripheral nerve control exerted through the plexus of Auerbach. The rate and degree of peristaltic movement is, however, controlled by the central nervous system through the vagi and the splanchnics. The vagi and splanchnics also contain afferent

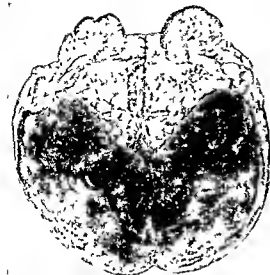


Fig 3. Hypernephroma of kidney. Middle of mass shows tumor, while lower third shows large blood-clot. With every recurrence of hemorrhage into tumor the patient had ileus-like symptoms.

stimulated by noxious stimuli is shown by the resulting vasoconstriction in the visceral vessels and the increase in the blood-pressure. A plausible explanation for the ileus described can be found in the above facts.

The receptors of the sensory nerves of the kidney, ureter, or peri-renal tissue are stimulated by the passage of a stone, or hemorrhage into or around the kidney. These severe painful stimuli reach the brain through afferent nerves and reflexly stimulate the splanchnic nerves which bring about a dilatation of the gut, a closure of the ileocolic sphincter, and an increased secretion of adrenalin, which augments the action of the sympathetic. Cannon has shown that such a mechanism is brought into play in case of acute pain emotions, fear, etc. Such relaxation of the intestines as is present in the reflex ileus described in this paper is probably too long in duration to be wholly explained by simple inhibition due to the mechanism of temporary stimulation of the splanchnics.

In trying to account for what appears to be a complete paralysis of the intestinal muscle following splanchnic inhibition, we are re-

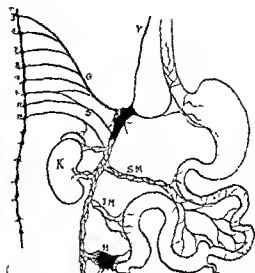


Fig 4. Diagram of relation of nerves of the kidney to those of the intestine (after Luciani). K Kidney, V vagus nerve to celiac ganglion, G greater splanchnic nerve, S smaller splanchnic nerve, SM superior mesenteric plexus, IM inferior mesenteric plexus, H hypogastric plexus. Note how nerves of kidney and ureter communicate in celiac ganglion with those of stomach and intestine.

minded of the interesting phenomena which have been observed in the case of the bivalve mollusk which can hold its shell closed in spite of a great deal of force expended to pull it apart. Parnas found that in the case of *dioxinia exoleta*, it required a weight of 2,400 grams per square centimeter to close the shell against the elastic cushion which forced it open. Yet, the animal can do this for a day at a time with no evidence of fatigue. This would seem to indicate that the muscles do not possess their tone because of a continuous excitatory process, but that the fibers are "hooked up," as it were, by what Bylles is pleased to call a "catch mechanism" for want of a better translation for the word *sperrung* proposed by Uexkuell. In other words, when the shell is closed, it is locked shut and held without the expenditure of nerve or muscle energy. If the shell of the mollusk is prevented from entirely closing by placing a piece of wood in the opening, the wood is grasped tightly. If this is removed by twisting or turning, the shell will remain apart and motionless as is the case

with the jaws of a vice when the object which they hold is forcibly removed.

If such a mechanism is responsible for the tone of the intestinal muscle, as it probably is, since the removal of the gut from the body does not cause the muscle to lose its tone completely, we might believe that dilatation and stasis in the intestinal tract, following reflex splanchnic stimulation, is due to a fixation of the muscles in the relaxed state just as in the case of the mollusk, whose shell remains open after removal of the stick, until the abductor muscle is excited and the lock released. We can conceive that the intestinal muscle remains in a greater or less degree of contraction, independent of nerve stimulation after its tone is once established. Extreme splanchnic stimulation by the reflex pain of renal colic, etc., would bring about a

temporary inhibition of visceral movements and a dilatation of the gut. If this is continued over a space of time, the intestinal muscles are locked in this position and a strong excitatory influence would be necessary to increase the tone of the now toneless muscle.

This explanation of the reflex paralysis of the intestinal muscles will serve at least as a working hypothesis until some better one is offered. Why it should not occur in every case of severe sensory stimulation of the nerves supplying the urinary tract we are also unable to say at present. We know that a similar paralytic condition occurs after torsion of the spermatic cord, or of the pedicle of an ovarian cyst or after a severe blow upon the abdomen without recognizable visceral injury.

SOME EXPERIMENTS WITH RUBBER GLOVES¹

By CARL E. BLACK, A M., M D., F A C S., JACKSONVILLE, ILLINOIS

WE have become so in the habit of the daily use of rubber gloves that for a number of years little has been written on the subject except to emphasize their necessity. The facts which I wish to present have nothing to do with the consideration of the use of gloves as a protection to the patient or surgeon against infection. Most surgeons seem to have come to the conclusion that the use of rubber gloves is a necessity and that the protection which they afford against infection outweighs all other considerations. It is not my intention to combat the idea that this is a very proper conclusion on the part of surgeons and undoubtedly it is almost universally accepted at the present time.

Notwithstanding this consideration, however, there are, no doubt, others than myself who have wished that their hands might be freed from the limitations of movement and touch which rubber gloves impose.

It is well known that a number of surgeons of international reputation for satisfactory

technique have never used, or have discarded the use of, rubber gloves. Most surgeons who do not use rubber gloves themselves insist on their use by their assistants. Several conspicuous examples could be mentioned and probably occur to each of us.

What I have to present is entirely from the standpoint of the practical interference which gloves offer to the sense of touch. This interference is not limited to the purely tactile sense but also interferes with our estimate of resistance and power of description. The interferences are partly due to the fact that if the gloves fit properly and closely to the skin in order to protect the sense of touch a certain amount of muscular energy is used to overcome the elasticity of the gloves.

All sensations received by the gloved fingers must be classified as "projection of touch" and theoretically can hardly be expected to possess all the qualities which the mixed sense of touch has in addition to the purely tactile sense, the auxiliary use of the hairs, and the quality of discrimination.

¹ Read before the Western Surgical Association, Des Moines, December 18, 1915.

While we are ready to admit that asepsis is of primary importance in operative surgery I always have a suspicion that we may be missing important information on account of some blunting of the sense of touch by the use of gloves. At least it is only fair that we know just what handicap the gloves give us as well as to study the possibilities of discontinuing their use.

I wish to report a practical experiment in the use of rubber gloves. It seemed to me that the blind who do all their reading with their fingers would give an opportunity for observation on the effect of rubber gloves on the tactile sense which could not be gotten in any other way. With the co-operation of Superintendent H. C. Montgomery, of the Illinois State School for the Blind, and Principal Mrs. L. B. Inglis, of the High School department of that school, six of the best finger readers among the High School students were selected. There were three boys and three girls. The plan of all the observations was the same, namely, to select one hundred (100) words (thirteen lines) of unfamiliar text and new type which had not been used before and to count the number of seconds required to read the 100 words. The figures in the accompanying chart are seconds of time used in reading 100 words. The text was Montgomery's *American History*, and was printed in the Braille which consists entirely of raised dots pressed into heavy paper. The Braille type is based on six (6) dots (1, 2, 3) that is, reading from the top to the bottom, then beginning again at the top, (4, 5, 6). All of the letters are combinations of those six dots (1, 2, 3, 4, 5, 6).

Four series of observations were made.¹ The first series consisted of the observations before any experience in the use of rubber gloves had been acquired.

Observation 1 The bare fingers were used. One hundred words of text was assigned to each pupil. The boys read in an average of 61 seconds and the girls in an average of 49 seconds, or in a general average of 55 seconds for the six pupils.

Observation 2 The hands were covered with thin weight rubber operating gloves. The three boys read one hundred words in an average of 77 seconds

¹For details and summaries of observation see table which accompanies this paper.

and the three girls in an average of 65 seconds or in a general average for the six pupils of 71 seconds.

Observation 3 The hands were covered with medium weight rubber gloves (such as are most commonly used by surgeons). The three boys read one hundred words in an average of 107 seconds and the three girls in an average of 63 seconds, or in a general average of 85 seconds for the six pupils.

In this observation it will be noted that the three girls seem to have read more rapidly with medium weight gloves than with thin ones. This apparent discrepancy is entirely due to the fact that pupil No. 4 had an easy free flowing passage which was easily read. This explanation is emphasized by her results in Observations 2 and 4 where her record is perfectly consistent with that of the others.

There are a number of places where an individual reading would need correction in this way. Instead of being easier than the average it may have been more difficult as for example a passage which contained an unusual number of names of unfamiliar persons or places. The average in seconds must be relied upon to give the correct estimate of speed.

Observation 4 The hands were covered with thick weight rubber gloves such as are commonly used in dressing rooms or by some surgeons in operating. Three boys read one hundred words in an average of 121 seconds and the three girls in an average of 92 seconds, or in a general average of 106 seconds.

It seems reasonably evident from these observations that the sense of touch is blunted just in proportion to the thickness of the covering over the touch organs, of the fingers; that is, the sense of touch, with medium weight rubber gloves covering the fingers, as compared with the bare fingers is in proportion as 55 is to 85, or to put it in another way the medium weight gloves seem to reduce the acuteness of the sense of touch by about 50 per cent.

The second series of observations was made on the same pupils after about two weeks, daily practice in the use of rubber gloves. I left them a supply of gloves with a request that they practice finger reading for a short time each day with the gloves on and I am assured the request was carried out.

Observation 5 The bare fingers were used. The boys read one hundred words in 64 seconds and the



Fig 1 Three young ladies reading Braille text with fingers

girls in 38 seconds or in a general average of 51 seconds

By practice the general average was reduced four seconds notwithstanding the fact that pupil No. 3 took almost twice as long to read as he did in Observation 1, and Observation 20 shows his general average for bare fingers to be only 57 seconds

Observation 6. The hands were covered with well fitting gloves of medium weight and each glove was selected to fit the hand which is the only difference between this and Observation 3. The three boys read the one hundred words in an average of 83 seconds and the three girls in an average of 48 seconds, or in a general average of 66 seconds. Comparing this general average with that obtained in Observation 3 it would seem that the two weeks' practice had improved the facility of reading through rubber gloves over 20 per cent.

Considering the great natural facility developed by the blind in using their fingers it would seem probable that this facility would not be further increased to any great extent by prolonged practice

Observation 7. The hands were covered with very loose, ill fitting rubber gloves of medium weight and such as are frequently used by nurses and assistants and not infrequently on the hands of surgeons. The three boys read one hundred words in an average of 115 seconds and the three girls in an average of 58 seconds, or in a general average of 86 seconds

The lesson from this observation is plain

Gloves should be carefully selected to fit the hand so that there will be no slipping or rolling of the rubber tissue on the fingers.

Observation 8. The hands were covered with medium weight, well fitting gloves containing an excess of talcum powder. The three boys read one hundred words in an average of 110 seconds and the three girls in an average of 46 seconds or in a general average of 78 seconds

This observation would seem to show that while an excess of powder in the rubber gloves causes considerable diminution in the tactile sense it is not as important a factor as loose or poorly fitting gloves

In the third series of observations instead of using paper books printed in Braille we used the brass sheets of Braille text from which the paper sheets are printed. These sheets of course are identical with the paper page except that the raised letters are on the brass sheets instead of on the paper. The letters on the brass look much smoother and more definite than on the paper but the teachers and pupils agree that the paper is more easily read

Observation 9. The bare fingers were used on Braille text on brass plates and one hundred words assigned to each pupil. The three boys read one hundred words in an average of 57 seconds and the

OBSERVATIONS IN FINGER READING WITH BARE FINGERS AND WITH RUBBER GLOVES BY HIGH SCHOOL PUPILS AT THE ILLINOIS STATE SCHOOL FOR THE BLIND JACKSONVILLE ILLINOIS

Observation Number	Each observation consisted of the numbers of seconds required for reading with the fingers 13 lines, or approximately 100 words of Braille text printed on both paper and brass. The test was new and unfamiliar and a new page was selected for each observation.	2 Carl Kuster	3 Frank Foster	3 Frank Thompson	4 Boys' Average	4 Marie Schaeffer	5 Johanna Crowley	6 Hannah Wessels	Girls' Average	Aves. for 12
	<i>Prior to any experience in the use of rubber gloves —</i>									
1	Bare fingers	65	68	59	61+	45	52	50	40+	51
2	Thin gloves	72	100	61	77+	67	60	65	63+	71+
3	Braille on paper —									
	Medium gloves	63	130	600	107+	53	65	75	63+	85+
4	Thick gloves	60	180	95	124	75	113	77	91	100+
	<i>After ten weeks' daily practice with rubber gloves —</i>									
	Braille on paper —									
5	Bare fingers	45	58	60	61+	35	35	45	38+	51+
6	Well fitting gloves (medium) dry	55	30	115	83+	46	45	55	45	66
7	Loose fitting gloves (medium) dry	70	105	120	115	50	55	70	56	86+
8	Excess of powder in well fitting gloves	75	95	160	120	45	45	50	46	73+
	Braille on brass sheets —									
9	Bare fingers	45	18	50	57	43	45	47	45	55+
10	Well fitting gloves (medium) dry	55	70	80	68+	37	37	45	38+	77+
11	Well fitting gloves (medium) hands wet	40	45	65	55+	30	35	33	32+	47+
12	Oil outside of gloves	65	107	100	80	43	44	47	43+	65+
13	Oil inside of gloves	80	90	100	90	47	50	53	55+	70+
14	Oil both inside and outside of gloves	51	74	70	65+	39	39	50	42+	54
	Braille on paper —									
15	Bare fingers	38	50	56	40+	30	35	39	30	35+
16	Oil outside of gloves	106	95	80	93	50	68	72	63+	77+
17	Oil inside of gloves	64	100	61	76+	44	55	52	50+	63+
18	Oil both inside and outside of gloves	65	80	58	71	55	50	57	50+	63+
19	Dry gloves, but paper text oiled	58	60	63	65+	45	45	57	49	57+
	<i>General averages —</i>									
20	Averages for bare fingers	47+	65+	57	55+	35+	42+	43+	40+	48
21	Averages for all medium gloves (dry)	61+	80+	114+	90+	45+	48+	58+	56+	70+
22	Averages for oil inside of gloves	65+	88+	71+	75+	45+	51+	53+	50+	68+
23	Averages for wet hands in gloves	60	105	68	80+	40	13	48	50+	66+
24	Averages for all glove observations	70+	99+	89+	85+	40+	50+	56+	54+	70+

three girls in an average of 45 seconds, or in a general average of 56 seconds

Observation 10 The hands were covered with well-fitting medium weight dry gloves and one hundred words of Braille on brass plates were given each pupil. The three boys read their one hundred words of text in an average of 68 seconds and the three girls in an average of 39 seconds or in a general average of 54 seconds

Observation 11 In this observation the gloves were put on wet—that is, filled with water and put on the hands, and one hundred words of Braille on brass plates given to each pupil. The three boys read their one hundred words in an average of 53 seconds and the three girls in an average of 32 seconds, or in a general average of 42 seconds

In all other observations the gloves were used perfectly dry and no more powder used (except in Observation 8) than was necessary to get the gloves on

It seems to be demonstrated in Observation 11 that gloves put on wet interfere less with the sense of touch than gloves put on dry. Each pupil remarked on this fact, saying that it was because the tissue did not slip about on the fingers so much

Observation 12 A perfectly refined mineral oil

was put on the outside of the gloves and brass sheets given to read. The boys read one hundred words in an average of 89 seconds and the girls in an average of 42 seconds, or in a general average of 65 seconds

Observation 13 The same as Observation 12 except that the oil was put on the inside of the gloves. The boys read one hundred words in an average of 90 seconds and the girls in 51 seconds, or in a general average of 70 seconds

Observation 14 The same as Observations 12 and 13 excepting the oil was both inside and outside the gloves. The boys read one hundred words in 65 seconds and the girls in 42 seconds, or a general average of 54 seconds

Observation 15 was a control and the bare fingers were used on paper Braille text. The boys read one hundred words in 41 seconds, the girls read it in 30 seconds, or a general average of 35 seconds

The fourth series of observations was with oil in which the paper text, instead of the brass sheets, was used

Observation 16 Was the same as Observation 12, except that the paper text was used instead of brass. The boys read one hundred words in 92 seconds and the girls in 63 seconds, or in a general average of 77 seconds

Observation 17 The same as Observation 13 except that paper text was used instead of brass plates. The boys read one hundred words in 96

seconds and the girls in 50 seconds, or a general average of 63 seconds

Observation 18 The same as *Observation 14* except that the paper text was used instead of brass. The boys read one hundred words of text in 71 seconds and the girls in 56 seconds, or a general average of 63 seconds

Observation 19 The hands were covered with dry gloves and the paper text was thoroughly oiled with mineral oil. The boys read one hundred words in 66 seconds and the girls in 49 seconds, or a general average of 57 seconds

Observation 20 Consisted of the averages of all bare hand readings (four observations and twenty-four readings). The boys had an average of 56 seconds and the girls an average of 40 seconds, or a general average of 48 seconds

Observation 21 The average of six observations and thirty six readings with the hands covered with medium weight gloves put on dry. The boys had an average of 90 seconds and the girls an average of 50 seconds, or a general average of 70 seconds, as compared with 48 seconds for the bare hands

That is in an average of sixty individual observations it required an average of 22 seconds longer to read with medium weight gloves than with the bare fingers or to put it another way the time was increased 45 per cent by the use of gloves. This is the central point of the experiment. What effect on technique does such a considerable blunting of the sense of touch have? Are we as surgeons reading our text as well as we should?

Observation 22 The average of four observations and twenty-four readings where oil was used in or on the gloves. The boys had an average of 75 seconds and the girls an average of 50 seconds, or a general average of 68 seconds, or a slightly better average than with dry gloves

Observation 23 The hands were put into the gloves wet. This average contains in addition to *Observation No. 21* two additional observations or three in all, although two of them are not given in detail. There were eighteen readings of one hundred words each and the boys had an average of 80 seconds and the girls an average of 50 seconds or a general average of 65 seconds

This observation seems to show that medium weight gloves put on wet interfere somewhat less with the sense of touch than any other plan and that thoroughly dry gloves on

thoroughly dry hands interfere with the sense of touch more than any other plan.

Observation 24 shows the average of all observations with gloves. The boys averaged 86 seconds (as against 56 seconds with bare hands, 90 seconds with dry gloves, 75 seconds with oiled gloves, and 80 seconds with wet gloves). The girls averaged 54 seconds (as against 40 seconds with bare fingers, 50 with dry gloves, 50 with oiled gloves, and 50 with wet gloves). The general average was 70 seconds (as against 48 seconds for bare fingers, 70 seconds for dry gloves, 68 seconds for oiled gloves and 65 seconds for wet gloves)

CONCLUSIONS

1 The use of medium weight rubber gloves requires the blind to use an average of 22 seconds more in reading one hundred words of Braille than with the bare fingers; namely, 48 seconds with the bare fingers, and 70 seconds with medium weight gloves. Or in other words, there is a loss of nearly 50 per cent in the sense of touch judging from the results of this experiment

2 The tactile sense is materially improved by putting on wet instead of dry gloves, the difference being an average of five seconds or a little less than 10 per cent. Gloves put on with oil on the hands give a slight improvement over dry gloves, namely, 68 seconds as against 70 seconds

3 The tactile sense diminishes in direct proportion to the thickness of the gloves as shown in our first series of observations where thin gloves showed an average of 71 seconds, thick gloves showed an average of 106 seconds as against an average of 48 seconds with the bare fingers

4 A marked improvement in the tactile sense is brought about by the use of carefully fitted gloves as shown in our second series where by care in fitting, the average was reduced from 70 seconds to 66 seconds

5 As a final conclusion we may say that the final result of the experiment is that gloves put on wet give the most favorable opportunity for exercising the sense of touch and gloves put on dry give the least favorable.

INJURIES OF THE SPINAL CORD

WITH REPORT OF GUNSHOT INJURY OF THE CORD AT THE FOURTH CERVICAL VERTEBRA AND SUCCESSFUL REMOVAL OF PROJECTILE

By AL GUST SCHACHNER, M.D., F.A.C.S., LOUISVILLE, KENTUCKY

THE following case was referred to me by the family physician, Dr Frank J. Kiefer, of Louisville.

Joseph H., age 33 years was accidentally shot by his cousin on October 5, 1912. The projectile was a .22 long, fired from a rifle, at a distance of about six feet. At the time of the accident, the cousin was standing and the victim seated at luncheon. The ball entered just below the malar process on the left side, ranging downward, backward, and inward.

It became arrested by embedding itself in the cervical portion of the cord, at a point corresponding with the junction of the column of C4 and C5. In its position the long axis of the projectile corresponded with the long axis of the cord. On being shot, he uttered a cry, fell from his chair and rolled up, as he expressed it, in a "ball."

He was unable to speak and lost consciousness. Directly after the accident, he was removed to the Jewish Hospital, a distance of about three or four miles from the scene of the accident. On reaching the hospital his condition was one of evident shock. His skin was pale and clammy. His pulse weak and collapsible.

Between the time of the accident and his being placed in the hospital bed covering a space of almost two hours and a distance of three or four miles, he lost and regained consciousness three times, the first time, on receiving the wound, the second, on being exposed to a sudden jar while carried through the hospital, and the third time as the result of handling which his undressing necessitated. The mucous membrane of his mouth was swollen, but unbroken, and particles of food were still present. Pressure at a point in front and below the angle of the jaw on the wounded side seemed painful. He afterwards spoke of both arms and legs as feeling dead, or being unconscious of possessing arms and legs. Hypertonus was noticeable during the first forty eight to seventy two hours. This gradually ceased.

Loss of expulsive action of the bladder and bowels existed for four days, with gradual return of function, beginning on the fifth, and practically complete return by the eighth day. The loss of consciousness was transient and hardly complete. The reaction from shock began almost directly after being placed in bed and commotion ceased. The return of motion was more rapid on the right side and in the arm. Return of function in the right arm began about the eighth day and was complete in three weeks. Beginning return of function

in the left arm, delayed until four and a half weeks. The right leg began to improve soon after the right arm, but improvement was not so rapid in right leg as in the right arm.

During this period he was considerably annoyed by involuntary jerking in the right leg. Improvement began in the left leg eight and a half weeks after the accident. A sense of deadness and heaviness throughout the body prevailed for about two weeks and was noticeable months thereafter during exercise. The first evidences of vasomotor changes were noticeable on the second day, the left hand had a glossy, full, and red appearance, with some tenderness to touch.

The left arm and leg exhibited circulatory changes most noticeable in winter and on allowing the arm to hang. The left arm would get cold before the left leg. The heaviness of the left leg, which some what remains, disappears partially with exercise, the left leg "goes to sleep"; the left arm is more tired than the right and involuntarily spasmodically extends itself. Two and a half months after the accident, spastic changes were well developed in the left arm and leg. Ducking or scratching with a pin, or stroking with a finger or finger nail, the ulnar side of the right arm, from its lower third downward to the little finger, especially the region represented by the distribution of the ulnar nerve and more on the palmar aspect of the hand, develops a shouldeer clonus on the left side. The gunshot wound healed primarily without any unusual local or general reaction.

On the fourth day after the accident, two radiographs were made, a lateral and an anterior view. The existence of the projectile was distinctly evident, and its precise location was interpreted by the radiographer as being in the region of the lamina of the third cervical vertebra.

First operation. On the following day (fifth) in the presence of the radiographer, an incision was made to the left of the cervical spine, and the second, third, and fourth cervical laminae exposed without finding the projectile. The incision was enlarged upward and downward, as far as the sixth lamina inclusive, without avail. The radiographer, who acted as pilot, suggested a corresponding point anteriorly instead of the lamina, as the probable location.

Second operation. The exploratory wound having healed, on the advice of the radiographer and surgical consultant, two weeks thereafter a second exploration was undertaken.

An incision was made along the anterior border of the sternomastoid muscle on the left side, the

carotid sheath pulled aside, and the pedicle and transverse process of the third cervical vertebra exposed to view. By continuing the exploration between the carotid sheath and the plexus of cervical nerves, the opening permitted a palpation of the region of the third and fourth cervical vertebra laterally and anteriorly, with negative results.

This, like the first wound, healed primarily. Following this operation, there was an improvement in the entire condition, due to the gradual subsidence through time of the effects of the destructive element of the injury. This improvement continued until the latter half of December, two and a half months after the injury.

Continued observation, from time to time, between December 1912 and April 1914, confirmed the opinion of a progressively destructive lesion and the necessity of further surgical efforts.

Third operation. Another set of radiographs was prepared and with the aid of a stereopticon, it was definitely settled that the projectile was within the spinal canal and at a point corresponding to the fourth cervical vertebra. On April 14 1914, an incision was made over the spine of the second to sixth inclusive cervical vertebra, and the lamina of the third and fourth cervical vertebra removed. Nothing abnormal was noticeable on opening the spinal canal, either by inspection, palpation, or the use of the probe. The membranes were opened and a profuse flow of cerebrospinal fluid followed. This was practically controlled by packing off the canal with gauze.

The location of the projectile was now apparent beneath the surface and to the left of the posterior median fissure. The overlying cord structure was incised longitudinally with a cataract knife down to the projectile, and the latter carefully extracted. As the openings in the membrane were almost closed, packing, that had been placed to control some venous bleeding from the side of the bony opening, became dislodged and at once the wound filled with blood that continued to well over its edges. Efforts to control this through forceps and packing were only partly successful.

The condition of the patient, which had been entirely satisfactory, now became so critical, that the entire wound was rapidly packed with gauze and a few silk worm sutures inserted to keep this in place.

He was removed to his bed in profound shock from which he reacted after the lapse of five or six hours. The packing was allowed to remain until the end of the fifth day. During these five days, the discharge of cerebrospinal fluid was sufficiently free to necessitate the change of the external dressing from once to twice a day.

At the end of the fifth day he was removed to the operating room and the wound edges from the skin surface to the bottom infiltrated with a half per cent solution of novocaine. Under this local anesthetic the packing was removed and the remaining opening in the membrane sutured and the

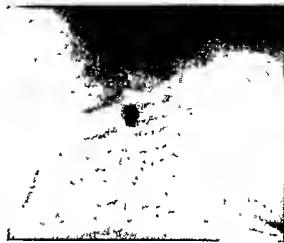


Fig 1 X ray showing location of bullet (See case report for description.)

wound closed. All of this and the primary healing of the wound was accomplished without any untoward effect. He left the hospital at the end of three weeks wearing a collar from the chin to the sternum, consisting of several layers of gauze, and three thicknesses of adhesive plaster. This was discarded two weeks later. The after treatment consisted in massage, electricity, and the correction of the left hand.

The drop-wrist, the extended first phalanges, and the flexion of the second and third phalanges, were brought into a straight line and held thus through a splint and plaster dressing for about eight weeks, with a distinct improvement in the condition.

Present condition, fifteen months after the third operation or the removal of the projectile from the cord. The bladder and bowels are normal. Sensation is diminished on the right as compared with the left side in the legs, except in the femoral regions where they seem alike. The same applies to the thermic test. Left side arm and leg suffer more from cold when exposed than right. Cyanosis and coldness of left hand absent since removal of projectile, as well as the sensation of pins and needles or crawling like ants. Left shoulder clonus developed by sticking lower ulnar region on right side with a pin but less so than formerly. Spastic paralysis of the left hand consisted of extension of the first phalanges and the flexion of the second and third giving the hand a clawing appearance.

MEASUREMENTS OF LEGS

	Inches
Right leg at calf	.12
Right thigh	.18 25
Left leg at calf	11.5
Left thigh	17

MEASUREMENTS OF ARMS

Right arm at middle	9
Left arm at middle	6

Measured about 2 inches below the elbow, there was a difference of 3 inches in favor of the right. This increased difference in the measurement of the upper extremity, over the lower, may be explained somewhat on the ground of the difference in use. He was better able to use his left leg than he was able to use his left hand. The use of the left arm showed little restriction over the right, but the same was not true of the left hand and therefore there was not as much use made of the left side as of the right.

The spastic condition of the left hand, as already described, interfered with his picking up and handling small objects, large ones could easily be cared for. The thumb was the most useful of the fingers on the left hand, and the usefulness diminished as we passed from the thumb to the little finger. This diminution was especially noticeable in the ring and little finger.

The left arm at rest hangs by the side suggesting limpness, and the left foot shows a slight eversion, little unsteadiness, and tendency to drag. The general picture suggests that of hemiplegia in a mild degree. He was unable to raise the left arm as high as the right, but the ability to raise the arm is very much improved since the last operation. Plantar reflexes increased on the left over the right side, knee reflex increased on the left and diminished on the right. He says the right side still has an indescribable abnormal sensation.

FREQUENCY

Frequency of gunshot injuries of cervical vertebrae are, according to Hoffmann, as follows:

In the Civil War they amounted to 0.25 per cent of all gunshot injuries, in the Franco-Prussian War, 0.36 per cent, in the Greco-Turkish war, 0.39 per cent, in the Spanish-American War, 0.55 per cent. So far as gunshot injuries of the cervical region, as compared with gunshot injuries of other spinal regions. Quene gives the following figures. Among the French during the Crimean War, the cervical vertebra 49 or 31.4 per cent, thoracic region, 74 or 48 per cent, lumbar region, 31 or 19.9 per cent. In the Franco-Prussian War, according to Graf and Hildebrandt, in 367 gunshot injuries of the vertebra, 93 were in the cervical region, 134 in the thoracic region, 62 in the lumbar region, 78 in the coccyx. In the Civil War, according to Otis, there were 382 gunshot injuries of the vertebrae, 91 in the cervical region or 23.5 per cent, 136 in the thoracic region or

35.8 per cent, 149 in the lumbar region or 39 per cent.

LOCATION, NATURE, AND EXTENT OF SPINAL INJURIES

Through a careful examination of the segmental disturbances, motor and sensory, coupled with the roentgen rays, the location of the projectile, and to some degree the osseous injuries in the majority of cases, can with reasonable certainty be determined.

When it comes to estimating the nature and extent of injury to the cord, it is a different matter altogether. Here a study of some of the accessible cases in the literature, notably those of Allen, Winslow, Murphy, Muller, Butt, and others, readily convinces one that the clinical data may be so misleading as not to be able to determine with reasonable certainty as to whether we have a destructive lesion with anatomic cord changes, or as to whether we have a case simulating a destructive lesion but clearing up with time; and vice versa, cases that in the beginning did not seem serious, but grew serious with time, days or weeks, and in some progressively growing worse until extensive paralysis, or death ended the scene—Henle, Barker, Murphy, and others.

While a carefully prepared set of radiograms, stereoscopically studied will supply valuable data as to the course of the projectile, and the probable nature of the spinal injury and from which valuable conclusions as to the possible existence and probable extent of cord injuries can be drawn, it is pardonable to emphasize the warning that the diagnosis, however carefully made, is frequently misleading. It is an easy matter to find in the literature reports from reliable sources, of quite a number of cases, which through time, operation, or autopsy, were shown to be in point of cord injury, just the opposite to that which in the beginning they were thought to be.

CONCUSSION

The term "concussion of the cord" is one about which there is a considerable difference of opinion, accepted by some and rejected by others. The term may be said to mean the impairment or loss of function without

the existence of gross anatomic cord changes. Muller says:

Stacks of literature have been written about it and many an expert witness has been paid a fee for testifying to its existence. But "to the impartial observer the conviction must be inevitable that the weight of evidence is against the existence of the condition" (Bailey). Many of the statements in favor of the state of concussion have been derived from the finding by the surgeon at operation of an apparently normal cord, but we now know that tremendous damage may be done to the cord, the white and gray matter being shaken up together and indistinguishable or one driven like a wedge into the other, and yet no visible external change is discernible. The comparison with the numbed and tingling nerve or the concussion is not a true one, as the surroundings of the cord are entirely different and the symptoms of its injuries never transitory.

Those rejecting the term do so mainly on anatomic grounds, the size of the cord as compared with the spinal canal, its curvatures, the presence of cerebrospinal fluid, and its ingenious suspension through the dentate ligament and nerve roots.

M. S. Barker in his paper "Traumatic Hæmatomyelia" affords satisfactory explanation of many of these cases. His classification includes four varieties: local, profuse local, disseminated, and profuse disseminated.

For many decades it was one of that group of unknown conditions (except symptomatically) known as railway spine. How many conditions were contained in this group is not known, but it is certain that one of the most important of the group was removed from it when hæmatomyelia was identified and placed in a category by itself. We now find ourselves facing a new danger that nearly all cases, that were once known as railway spine, are now placed, or in danger of being placed in the category of hæmatomyelia (Barker).

COMPRESSION OF CORD

Compression of the cord may be due, primarily, to the presence of a projectile or other substance, or a portion of a vertebra impinging upon the cord. Secondly, the compression may be due to oedema or hæmorrhage. The effects of pressure on the cord in rare cases may be greatest on the side opposite the lesion (Hunt and Woolsey). According to Bruns, the segmental root pains, indicating the level of the lesion, are due to

compression of the segment from which the root springs and not to pressure upon the root in its intraspinal course.

The hæmorrhage may be extradural, intradural hæmatorrhachis, or both extra- and intradural, or into the cord substance, hæmatomyelia. When the hæmorrhage is into the cord substance, it may give rise to a cyst, which is responsible for a traumatic syringomyelia.

When we suspect a hæmatorrhachis, a lumbar puncture will confirm the existence of the same, as well as relieve if practiced early, the pressure within the space. Twenty to forty cubic centimeters of fluid should be drawn off.

Hæmatomyelia, as a pathologic entity, is of comparatively recent origin and, according to Thorburn and others, is underestimated in its frequency. Six out of his twenty-one cases of injury to the cervical spine showed hæmorrhage into the cord and unaccompanied by any apparent injury to the column itself.

Thorburn's and Parkin's cases of hæmatomyelia all occurred in the cervical region and at about the same area. This was partly attributed to acute flexion. That other causes than flexion are responsible is proved by the number of cases in which hæmatomyelia occurred without acute flexion. It has been pointed out that the hæmorrhage selects the grey matter of the cord over the white because the vessels are less firmly supported in the grey matter. As the grey matter is most predominant in the cervical region, it is the most favorable region for its occurrence.

Cushing believes that the possible existence of a special vessel, or vessels, such as Charcot's artery in the brain, is the best explanation of its occurrence in one special area of the cervical region. Since its occurrence in other regions, unless attended with some gross spinal lesion, is of comparative rarity, the lower cervical region, primarily the eighth cervical, up to the triceps level, is considered the favorable region for hæmatomyelia. (Cushing, Berkley, Hoch, Lloyd, Schmaus, and others). Barker has pointed out that when hæmorrhage does occur in the white matter, its progress is hindered by the barrier which the axones offer.

DESTRUCTIVE LESIONS OF CORD

These lesions may be due to the initial injury or to hæmorrhages and changes that follow secondarily. They may be limited or extensive in their scope. They may be early or late in their manifestation, and they may be stationary or progressive in character. The progressive character may be dependent upon a continued irritation due to the presence of a foreign substance as the projectile, or an irritation, edema, or a degeneration due to a traumatic myelitis, or secondary changes following a hæmatomyelia. The degree may vary from that of a contusion to a complete transverse lesion involving the destruction of a limited or extensive area of the cord.

The practical side of destructive lesions depends upon the extent of the destruction. Upon this rests the question involved in the surgical treatment, namely, as to whether or not operative interference is indicated.

With what certainty can we determine the existence of a complete transverse lesion?

According to Thomas, the factors in drawing the conclusion that there is a complete transverse lesion of the cord are:

1. Complete paralysis usually of the flaccid type.
2. A complete loss of sensation in all its forms.
3. Absent reflexes, especially the knee-jerk, while the planter reflex, on the contrary, is often retained.
4. Complete paralysis of the bladder and rectum with priapism.
5. Vasomotor paralysis with severe sweating in the paralyzed parts.
6. And most important, absence of variations in the symptoms.

7. Absence of irritative phenomena such as pain.

Walton, who has studied fractures of the spine, states there are no symptoms which establish (other wise than through their persistence) irremediable crush of the cord. While total relaxed paralysis anæsthesia of abrupt demarcation total loss of reflexes, retention, priapism, and tympanites, if persistent, point to complete and incurable transverse lesion, the onset of such symptoms does not preclude a certain degree, at least, of restoration of function. He also states that we have no infallible guide to the extent of the lesions. *Loc cit* Burrell.

TREATMENT OF SPINAL INJURIES

A careful consideration of the spinal injuries, as they are revealed in literature, justifies one in emphasizing the importance of not too readily dismissing injuries of the back as sprains; and sprains of the back that

persist should be carefully examined, and, if necessary, X-rayed.

No effort should be made to elicit crepitus in injuries of the cervical region. This should be replaced by the roentgen ray. In the first-aid handling of the subject suspected of spinal injury, it is desirable to exercise care and to keep and transport them as much as possible in the position in which they were found, until more definite information, as to the nature of the injury, is obtained. It seems needless to say that an air or water bed and the catheterization under the strictest precautions should be carried out. Shock, which is rarely absent, is the first indication.

The roentgen ray, spinal puncture, and a careful neurological study is the diagnostic triad upon which we are dependent. The radiogram should be studied stereoptically. The spinal puncture will not only afford data as to the existence of a hæmatorrhachis, but, through the withdrawal of fluid, will relieve the pressure. It will not permit of a differentiation between a hæmatorrhachis and a hæmatomyelia. The symptom-complex of both is similar. In meningeal hæmorrhage the chief stress is laid upon the irritative phenomenon, acute and immediate spinal pain increased by spinal movement. Radiating pains from the supposed pressure of the blood on the spinal root and referred over their distribution is characteristic, and on it Kocher lays especial stress (Cushing).

In intramedullary hæmorrhage the paralysis is frequently of the Brown-Sequard type, due to unilateral compression, and may increase in keeping with the hæmatomyelia. The duration of symptoms in hæmatomyelia is longer in hæmatorrhachis and, owing to the tendency to a syringomyelia, may leave permanent traces.

The examination of the spinal fluid will set at rest the question of infection, should this be suspected. In this connection, the suggestion of Woolsey, that the investigations of Crowe be utilized, is worthy of trial. Crowe developed the fact that urotropine is eliminated through the cerebrospinal fluid and the maximum of elimination is reached in from one-half to an hour after its administration. Woolsey therefore suggests the giving of fl-

teen grains before the operation and its continuance for several days, giving thirty grains or more every twenty-four hours, thus inhibiting the growth of organisms and the dangers of meningitis.

It is difficult to avoid the conclusion that an accurate estimate of the cord destruction is frequently impossible. If this fairly represents the status, is it not proper to lay down the axiom, "When in doubt, explore"?

Such a course is only in keeping with the trend of present surgery in serious conditions in other regions, whenever doubt exists. The fact that laminectomy is not as simple as most other explorations, should, in competent hands, not be a sufficient bar.

The development of surgical technique should naturally carry with it a growing increase in its application. The rules in vogue one or two decades ago should hardly hold, or at least with the same force today as they did then. Furthermore, such a position is supported by operative results as follows:

C. E. Black reported a collection of 552 cases taken from the literature. Of the cases operated on, 49.7 per cent recovered and 40 per cent died, of those not operated on, 25 per cent recovered and 65 per cent died. The fracture cases gave the following figures: the mortality of operation in the cervical region was 71 per cent, without operation, 85 per cent, in the dorsal region, 48 per cent, without operation, 64 per cent, in the lumbar region, 26 per cent, without, 50 per cent. Many of these cases are old and before the technique of aseptic surgery reached its present perfection.

Even as long ago as 1898, Frewitt tabulated 49 cases of gunshot wounds of the spine treated since the aseptic era. Of this number, 24 were operated on, with 13 deaths, and 25 were not operated on, with 17 deaths. Haynes collected the cases of gunshot injury from the date of Frewitt's paper, up to 1906, and found a mortality of 42.5 per cent in the operated cases, and 69.25 per cent in those not operated on (Muller).

Nowhere is timeliness more important than in spinal surgery. After the subsidence of shock and the adjustment of the nervous system to a condition where some conclusion can with more safety be drawn, the earlier the operation is performed, the better.

Degeneration is by many supposed to begin about the fourth day. Cases where a careful study justifies the opinion of a com-

plete transverse lesion or where it is believed to be a contusion or hematomyelia, operation is contra-indicated. In the first instance it is generally considered hopeless, except in the caudal zone, and in the other instance it is useless. Where, however, the evidence is not absolutely convincing, especially after a cautious delay and reasonable doubt still exists, exploration should prevail.

If modern surgery can lay claim to any achievement, it is the elimination of doubt, through cautious exploration, and the fact that some exploration can be shown to be useless or even a few fatal, does not, in the writer's judgment, invalidate the broad application of the rule.

Even late operations are not without their advantages, as the writer's case proves. It is difficult to disprove that advantages did not attend, through decompression, many of the explorations in which the surgeon did not make any definite move after the cord was exposed.

The ultraconservative views on spinal operations have been presented by Allen (3).

The question of a transverse lesion, with complete destruction of the cord and the possibility of its regeneration through myelorrhaphy, is an open one. The claim that evidences of at least some regeneration exist is made by those who have practiced the procedure, namely, Briggs 1898, Hart and Stewart 1902, Fowler 1905, Shurres 1905, and Estes of Bethlehem, Pa.

On the other side, the possibility of regeneration is doubted or denied, except in the caudal zone, by Muller, Murphy, Thompson, Krause, Crumston, and others.

Ramon y Cajal and Marinesto have demonstrated that repair does not occur in myelorrhaphy. These observers only encountered neurofibrillae, having a very irregular course and composed of amyelinic fibers and hardly any of them passed through the cicatrix; therefore histologically there is no medullary regeneration, so that the case recorded by Stewart and Hart remains still unexplained (Crumston).

BIBLIOGRAPHY

1. CUSHING, H. W. Hematomyelia from gunshot wounds of the spine. *Am J M Sc.* cxv, 654

2. HOFFMAN, ADOLPH. Zur Klinik und Behandlung der Halswirbelbeschüsse. Deutsche Zeitsch f Chir, 1901, 537.
3. ALLEN, A. R. Injuries of the spinal cord. J Am. M. Ass., 1, 941.
4. McRAPHY, J. B. Surgery of the spinal cord. J Am. M. Ass., v, 48, 765, also, Surg. Gynec. & Obst., 1907, iv, 385.
5. HENLE, A. Traumatischen Erkrankungen der Wirbelsäule. Arch f klin Chir, li, 1.
6. BARKER, M. R. Traumatic hematomyelia. Ann Surg., Phila., xvi, 678.
7. MIXTER, S. J., and CHASE, H. M. Operation in spinal cord injuries. Ann Surg., Phila., xxiii, 405.
8. WINSLOW, RANDOLPH. Complete transverse destruction of the spinal cord from pistol wound, without penetration of the spinal canal. Tr South Surg & Gynec Ass., 1910.
9. HART, and STEWART. Phila. M. J., 1902, June, 7.
10. BURFELL, H. L. Fractures of the spine. Ann Surg., Phila., xlii, 431.
11. FOWLER, G. K. A case of suture of the spinal cord following gunshot injury involving complete severance of the structure. Ann Surg., Phila., xlii, 507.
12. THORNTON, WM. Contribution to the surgery of spinal cord. Brit. M. J., 1894, i, 1346, Manchester Med Chron., 1892, xvi.
13. HAHN, L. Ueber Rückenmarks Chirurgie. Deutsche Zeitsch f Chir, 1902, lxii, 426.
14. DEBBY, R. Gunshot injury of the spinal cord. Ann Surg., Phila., li, 686.
15. KOCHER, THEO. Die Verletzungen d Wirbelsäule zugleich als Beitrag z. Physiolog d menschlichen Rückenmarks. Mittl. a. d. Grenz. d. Med. u. Chir., 1896, I, 5.
16. CUMSTON, CHAS. G. Gunshot wounds of the spine. N. Y. M. J., 1914, Oct. 17.
17. PILCHER, L. S., and OVRU, B. Penetrating gunshot wound of the cervical portion of the spinal cord. Ann. Surg., Phila., xxviii, p. 819.
18. MILLER, G. P. Laminectomy for injury and tumor of the spinal cord. Ann. Surg., Phila., liii, 754.
19. PREWITT, THEO. F. Gunshot injuries of the spine, with report of a case. Ann Surg., Phila., xxviii, 187.
20. HENT and WOOLSEY. A contribution to the symptomatology and surgical treatment of spinal cord tumors. Ann Surg., Phila., lii, 189.
21. PARKES, ALFRED. Seven cases of intraspinal hemorrhages. Guy's Hosp Rep., 1891, lxviii.
22. BARKLEY. Spinalgomyelia. Brain, 1900, xii.
23. CROWT. Johns Hopkins Bull., 1909, xi, Apr.
24. THOMAS, J. J. Boston City Hosp. M. & S. R. port., 1900.
25. WALTON, G. L. J. Nerv. & Ment. Dis., 1902, Jan.
26. COLEY, WM. B. Bullet wound of spinal cord. Ann of Surg., Phila., lii, 69.
27. SMITH, D. A. Regeneration of axones of spinal neurones in man. Montreal M. J., 1905, xxviii, April.
28. KRAUS, FEDOR. Chir. Gehirns u. Rückenmarks vol. ii, p. 817.
29. THOMPSON, JAMES E. Tr. Tex. State M. Ass.
30. BUTT, A. P. Destruction of the spinal cord by molecular vibration. Surg. Gynec. & Obst., 1915, ix, 480.

THYMUS DEATH

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ONE of the most fascinating and at the same time imperfectly understood conditions is the so-called thymus death.

An immense amount of work has been done on this subject and the problems presented have been studied from various viewpoints without clarifying the situation to any great extent. Arbitrary statements usually based on entirely insufficient data are made by various observers. Thus a pathologist may have autopsied a considerable number of cases which neither he himself nor anyone else had observed accurately during life. Or a surgeon may have operated on one or two cases with or without satisfactory result and has failed to give a complete record of the case. Again many cases are studied from the standpoint of the minute anatomy without regard

to the gross pathology or the clinical manifestations. It is this incompleteness of the work of the various observers that serves to make this problem appear hazy and obscure.

In order to better understand the pathology a brief review of the anatomy and physiology of the structures involved in the morbid process is here given.

The thymus gland develops as a paired organ from the ventral part of the third branchial cleft. These unite early in the embryological development, and at birth the thymus lies in the superior and anterior mediastinum extending downward as far as the fourth costal cartilage and lying on the surface of the pericardium and superficial to the innominate veins. It reaches above somewhat higher than the jugular notch and pro-

longations of each lobe upward may reach the thyroid (L. S. Dugeon, 1). Probably no other organ of the body shows so much variation as to shape and size. There is no constant morphology of this gland. W. M. L. Coplin (2) divides the various thymi into groups—unilobular, bilobular, trilobular, and conglomerate thymus. Each of these groups is divided again into three types, cervical, thoracic, or cervicothoracic according to the position of the gland. N. B. Harmon (3) found some cases in which the thymus tissue extended along the carotids to their bifurcations, and often intimately associated with the vagi nerves. Accessory lobes occur that may be independent of or united with the thymus or thyroid glands. Jacobi (4) points out that the thickness of the gland is very important and says that the distance between the vertebrae and the posterior surface of the manubrium sterni is 2 cm. He calls this the critical distance, and thymi that encroach upon this abnormally cause pressure symptoms and pathological changes. The thymus is movable and ascends on expiration (L. Rehn, 5).

According to A. Hammar (6) the so-called Hassall's corpuscles and the polymorphic fixed reticular elements of the gland are definitely entodermal in origin. The lymphocytes are supposed by Stoebr (7) to be due to a partition of the epithelial cells while Hammar and Maximow (8) believe that they arise from a secondary ingrowth of mesodermal elements.

The average weight of the thymus gland at birth is 12 grams (Hammar) and it increases after birth according to Hammar, V. Sury, Schridde, Ronconi, Pappenheimer, and others, until sexual maturity. The thymus tissue gradually atrophies and is partly replaced by fat, although appreciable remnants of thymus tissue are retained until late life. Accidental involution may occur in fasting animals (Hammar and Jonson, 9), and after irradiation with X-rays (Ribadeau, 10), and in chronic diseases associated with marasmus.

Little is known about the physiology of the thymus gland. It would seem from the experimental work of Klose and Vogt (Basch,

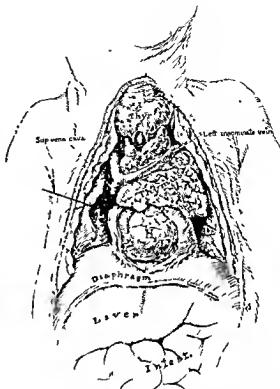


Fig 1 Drawing showing findings in author's case

11), H. Mathi (12), and others that it is intimately related directly or indirectly with the calcium metabolism. This influence is predominant in the early weeks of life, later becoming negligible. After complete thymectomy in dogs only a few days old, growth became retarded as compared with normal animals. The bones became more flexible and ossification was retarded. Callus formation was very poor. Calcium elimination was essentially increased. Dentition was delayed and an increase in the body fat was seen (stadium adipositas). This was followed by a gradual loss in weight in spite of increased appetite, muscular tremors, apathy, incoordination due to degenerative changes in the spinal cord, anaemia affecting both reds and haemoglobin, and a failure of the leucocytes to respond to the injection of chemotactic agents. Death finally occurred in coma.

Mathi also describes a broadening of the medullary portion of the adrenal gland and enlargement of the thyroid and pancreas.

When the same operation is performed on somewhat older animals serious disturbances of growth occur which disappear later.

When we turn to the pathology of the thymus gland we find again little exact data, and conflicting views advanced by many different authors. Aplasia of the gland is sometimes found. The condition is not infrequently associated with other malformations, especially with brain defects (Winslow, 13; Katz, 14; Bourneville, 15, and others). Total extirpation of the thymus has been carried out; but according to the experiments of Klose and Vogt (16) on animals it is not to be advised. In this connection the experience of Koenig (17) is interesting. The thymus was removed from a 9-months-old child for the relief of dyspnoea. The breathing became normal, and afterward there developed a severe rachitis on account of which the child first learned to walk at 4 years of age.

The condition of greatest clinical interest, however, is thymus hyperplasia. From a review of the opinions of the various authors it would seem that the thymus death cases may be grouped into two great classes.

Status thymicus. A group of cases in which the thymus gland is greatly hyperplastic and gives clinical and anatomical evidence of compression of the great vessels, nerves, and trachea. In these cases there is no change in other glands or organs of the body. Several cases have been operated upon with removal of greater or lesser amounts of the thymic tissue, and often with good results. L. Rehn (5) has had several cases in which the clinical picture was that of tracheal stenosis, in some of which a tracheotomy had been done without relieving the symptoms, because the stenosis was too low. He says further that the trachea may be compressed at various levels, but the most constant and most extreme degrees of compression are noted where the innominate artery crosses the trachea. He believes that the compression of the trachea may be increased in these cases in several ways. First, by the bending back of the head, causing an acute lordosis and thereby lessening the critical space. Second, acute swelling due to active or passive congestion of the gland. He mentions, as such, cases of

sudden death following the tying off of the arteries or veins at the lower pole of the thyroid during thyroidectomy. He quotes Gluck and Dwornitschenko to the same effect. Third, swellings of the gland occurring in the acute infectious diseases, especially diphtheria. Heinrichs (18) reports a case in which the enlarged thymus caused dysphagia as well as dyspnoea.

Some evidence has been advanced for the view that in certain cases the compression of the great vessels is the most important factor in the cause of death. Thus Hans Cohn (19) reports a case of death in a 7-months old child following a slight cold. Cyanosis and dyspnoea developed with no lung findings. The heart was found to be greatly hypertrophied and enlarged and there was great dilatation of the branches of the aorta. Lange (20) reports a similar case in which slight symptoms had been present for 8 months. At autopsy the thymus gland was found surrounding the great vessels and the bifurcation of the trachea. There was no evidence of compression of their passages, but the great vessels were greatly flattened and the heart was greatly dilated and hypertrophied. Zander and Keyhl (21) report an interesting case in which clinically there was dyspnoea with slow pulse but without cyanosis. The autopsy showed a thrombosis of the left internal jugular vein for one-half inch at its entrance into the thorax. Also a greatly enlarged thymus, especially in its anteroposterior diameter. Caillé (22) reports a similar case with convulsions.

Status thymico lymphaticus. The second great group are the cases in which an enlarged thymus is found in association with a general enlargement of the lymphatic tissue and frequently changes in the other ductless glands. Another very important finding in these conditions according to Wiesel (23) and Hedinger (24) is an associated hyperplasia of the chromaffin tissue of the body. A Paltauf (25) also drew attention to the associated narrowing of the vascular system in these cases.

It would seem from this view of the condition of thymic death that a careful distinction must be made as to the cause of the death in a given case. The dogmatic statement of

Friedleben (26) that there exists no thymic asthma is wrong; also the view of Palttauf that all cases are to be regarded as of lymphato-chlorotic constitution is incorrect. We must agree with Jacobi when he says that pressure from an acute congestion of the thymus on the trachea, great vessels, and nerves explains a certain number of these cases of thymic death but not all. Virchow (27) and Cohnheim (28) both state that the thymus can cause tracheal stenosis. Brouardel (29) points out that erroneous conclusions may be drawn at autopsy because the trachea and bronchi regain their cylindrical shape after removal of the sternum, even if they were compressed before. L. Rehn calls attention to the same point and believes that all cases should be hardened before opening the thorax in order to preserve the proper relations.

Halstead (30) has called attention to the association of thymus hyperplasia and Basedow's disease. He quotes Garré's (31) figures gathered by his assistant Dr. Chapelle in which a thymus persists hyperplastic was found in 95 per cent of fatal cases of Basedow's disease, whether death was due simply to the severity of the disease or occurred during operation, or within 24 hours after strumectomy. Three primary thymectomies have been done in Garré's clinic for the relief of symptoms of Basedow's disease with good effects on the general condition and the blood picture in each case. Von Haberer (32) reports a very interesting case in which a man of 30 years suffered for 3 years with symptoms of exophthalmic goiter. During this time he had had a part of the gland removed and the arteries of the remaining lobe tied off at a secondary operation. He presented himself at von Haberer's clinic in a state of collapse so severe that operation was at first refused and only eventually undertaken as a last resort in response to the pleadings of the patient. A small piece of thymus tissue was removed 3 cm x 0.5 cm under local anaesthesia. Complete recovery followed.

Halstead concludes that the thymus gland may play an important part in Graves' disease and in certain cases may play the title rôle, and that some of the puzzling features of this disease may be interpreted by the discovery

of the influence that the thymus may excite. He quotes the experiments of Gudernatsch, who fed to groups of tadpoles equally developed thymus and thyroid. Those receiving thymus increased greatly in size without differentiation or change of form. Those receiving thyroid put forth arms and legs and rapidly took on the characteristics of the frog.

The enlargement of the thymus gland in association with diseased conditions of other ductless glands is to be noted. According to Falta (33) it is found to have supernormal parenchymal value in many cases of Basedow's disease, also in acromegaly, in hypophysial dystrophy, in myxoedema, in eunichoidism, etc. Obviously, therefore, since it occurs in conditions of hypofunction as well as hyperfunction of these glands the real significance of the hyperplasia is difficult to determine.

A peculiar group of cases has been reported occurring in families, several children dying with the classical symptom-complex of hyperplasia of the thymus.

The symptoms in this condition are those referable to an enlarged thymus causing pressure upon the mediastinal structures with or without the associated changes found in status lymphaticus according to whether the condition is a status lymphaticus with especially large thymus or a pure status thymicus.

The onset varies in different cases. Symptoms may be present at or shortly after birth, and usually appear during the first year. They may appear suddenly in a previously apparently normal child or gradually and with increasing severity. The cases of sudden death without any premonitory symptoms are usually cases of status lymphaticus plus thymus hyperplasia.

The symptoms referable to the enlarged gland are *dyspnœa* either constant or paroxysmal, usually aggravated by exertion, such as crying, fits of anger, sudden retraction of the head, or in association with attacks of acute infectious diseases, especially diphtheria. *Cyanosis* which is usually associated with the *dyspnœa* and is likewise paroxysmal and is partly due to the narrowing of the air passages, pressure on the vagus nerves and on the heart

and great vessels. This may be the only symptom giving rise to the "forme cyano-tique" of Marfan. Tumor appearing in the suprasternal notch on strong expiration and disappearing on inspiration. *Slow pulse* in some cases probably due to pressure stimulation of the vagus nerve. *Changes in the voice* which vary from a slight and transient hoarseness to a complete aphonia, due in some cases to pressure on the trachea and larynx and in others to pressure on the recurrent laryngeal nerves. *Dysphagia* may in extreme cases completely prevent swallowing.

Physical findings. Inspiration and expiration may be prolonged and deepened, and auscultatory findings of a capillary bronchitis are common which may go on to a bronchopneumonia, especially in the late stages of the fatal cases. Percussion may reveal a movable tumor behind the sternum, but results obtained by this method are not very reliable as pointed out by Park and McGuire (34). Radiograms may show a shadow in the region of the thymus which blends with that of the upper border of the heart. The gland may be palpated in the suprasternal notch on expiration in some cases.

Blood findings. There may be a lymphocytosis which is usually of the small mononuclear type and may reach 50 or 60 per cent. Eosinophilia in slight degree (2 to 4 per cent) is noted in some cases. According to Wiesel (23) this finding is absent in the cases of pure status thymicus.

In the cases associated with the typical status lymphaticus, the above symptoms may be displayed, but usually are present in less degree, and the predominating feature of these cases is the picture of status lymphaticus with the enlargement of the lymphatic structures of the whole body, pasty skin, adiposity, and associated changes in the chromaffin system. These are the cases particularly in which sudden death occurs without prodromes.

The diagnosis of this condition is based upon the foregoing symptoms combined with the physical findings. Of special interest is the warning of Klose and others against prolonged exposure of the thymic region in young children to the X-ray because of the

destruction of thymic tissue by the irradiation.

Park and McGuire (34) call attention to the difficulty of accurately mapping out the thymus by the clinical methods available. They believe the thymus to be a relatively immobile organ and that the movable dullness obtained on percussion is probably due to the upward advance of the lung margins.

Jacobi (4) advises percussion of the thymus region with the child in the prone position. Boggs (35) believes that the gland is movable and that this can be demonstrated by percussion. The lower border of the gland moves as much as in interspace when the head is moved from extreme flexion to extreme extension, with the patient in the sitting position. He also points out that dullness due to enlarged thymus is higher and more superficial than that due to diseased mediastinal lymph-glands or other forms of mediastinitis. Thymic dullness also extends more to the left of the sternum than to the right. Emmerson (36) believes that both percussion and radioscopes have limitations, and that they are of less value in older patients. If we bear in mind the great morphological variations in the gland this view is strengthened.

Differential diagnosis would have to include enlarged mediastinal lymph glands from various causes, mediastinal abscess, benign and malignant tumors invading the mediastinal space, congenital cardiac lesions, hyperplasia of aberrant retrosternal thyroid, congenital stenosis of the oesophagus, laryngismus stridulus, laryngeal diphtheria, spasm of the glottis in parathyroid insufficiency, and aneurism of the arch of the aorta. The differentiation is usually easy with the symptoms and physical signs given above, and of especial value are the X-ray and fluoroscope. The bronchoscope is of value in diagnosing the tracheostenosis in older children.

The treatment of the condition is removal of part of the gland in the cases where pressure causing tracheostenosis threatens life. This can be accomplished by entering the thorax above the suprasternal notch, under local or general anaesthesia, according to the demands of the individual case. Care must

be taken not to remove the whole gland in very young children because of the metabolic disturbances engendered, as in the case of Koenig, and as shown by the experimental work of Klose and Vogt "Thymectomy subtotale souscapsulaire," described by Veau and Olivier (52), is the operation of choice. C. A. Parker (53) has given an excellent review of the surgical literature up to 1913, and he describes this operation and reports a successful case of his own.

Irradiation with the X-ray has been tried by Friedlander (37), Mayers (38), Halstead, Ribideau, Rachford (39), and with some success. Its use should be restricted to older children and adults for the reasons mentioned above.

No uniform results have been obtained from treating these cases with thyroid extract and thymus tissue. Spontaneous recovery occurs not infrequently even after several attacks of dyspnoea extending over years (L. Rehn).

Care must be exercised in operating on cases showing evidence of status lymphaticus as well as enlarged thymus as it is in these cases that sudden death during narcosis so frequently occurs.

Also as illustrated by this case reported below surgeons should keep in mind the possible anomalous position of the mediastinal blood-vessels with a view to avoiding injury to the same with serious consequences.

The following observations were made on a case of thymic death which apparently falls in the group of status thymicus, and which is associated with a rare anomaly of the left vena innominata. Unfortunately I did not see the case before death, and therefore have to depend on the statements of others, who did not make detailed observations, and on the rather incomplete clinical records on the history sheet.

The history is as follows:

Full-term pregnancy in a primiparous woman 24 years old. Labor was normal in every respect, presentation was cephalic occipito-*anterior*, and terminated spontaneously in 36 hours. The baby breathed spontaneously, and no difficulty in breathing occurred until about 2 hours after delivery when it was noticed that the respirations were somewhat difficult and that the child was cyanotic. This condi-

tion prevailed for about 2 hours when the cyanosis deepened, the respirations became more difficult, and the child died. There were no convulsions. Ante partum and post partum the heart-tones were normal. Just before death the pulse went down to 30 per minute. No other observations of the baby's pulse were made. A tentative diagnosis of patent foramen ovale was made. An autopsy was performed 5 days after death—the body in the interval being kept on ice.

Autopsy record in brief. The body is that of a well nourished male infant 50 cm long, weight 4 pounds 14 ounces. The skin of the head and neck, arms, and thorax appears red and congested. There are no deformities. The superficial lymphatics are not enlarged. The testicles are descended. The head shows no signs of trauma.

On opening the body there is present a moderate amount of subcutaneous fat. The pericardial sac contains a large amount of serosanguinous fluid. The pleural cavities are normal. The abdominal cavity is negative. The left lung is compressed and pushed to one side by a large thymus, which is a heart-shaped organ situated slightly to the left of the median line and extends from the lower border of the thyroid above to the fourth rib below. It is 4 cm broad at its widest part and $5\frac{1}{2}$ cm. long. Crossing the upper portion of the thymus from left to right at the upper border of the clavicle to the level of the lower border of the first rib is the left innominate vein. This has compressed the thymus, and lies in a groove on its surface. A branch of this vein leaves the thymus tissue at about the mid line of the body.

The inferior thyroid vein empties into the left innominate vein at the left border of that portion of the thymus lying above this vein. About $\frac{1}{4}$ cm. above this junction it receives a large branch from the thymus. There is no evidence of thrombosis in the thymic veins, left innominate, or superior vena cava.

The weight of the thymus could not be determined because of the desire to preserve the specimen intact. (Moreover according to Scheele (40) the weight of the gland has little to do with its power to compress the trachea.)

There are subpericardial petechial hemorrhages present in the heart, and it appears normal in size. The ventricular septum is intact, and the foramen ovale is closed by a septum. The ductus arteriosus is present and patent. The posterior portions of both lungs are markedly edematous in all lobes. The anterior portions are lighter in color and contain less fluid. Edema of the posterior portion of the lung is more marked on the left side. The kidneys are normal in size, and show fetal lobulations. Cortical petechial hemorrhages are noted. The adrenals show no gross lesions, and are not enlarged. The liver and gall bladder are about normal in size and there are no gross lesions. The spleen is normal in size, shape, and consistency. Extremities are negative. There are no scars or deformities. The

stomach and intestines are negative. The cranial cavity was opened after the brain was allowed to harden in Kaiserling I solution for 2 days.

The head measurements are as follows 13 5 M O, 11 5 I O, 9 5 S O B, 9 0 B P, 8 5 B T

The fontanelles are open and normal in size.

The hypophysis is normal in size. There is no cerebral or meningeal hemorrhage and no evidence of inflammation or trauma.

Histological examination made of the hypophysis, thymus, thyroid, adrenal, and spleen revealed no abnormalities.

The trachea was opened just above the upper edge of the main portion of the gland. There was evidence of compression of the trachea by the main body of the thymus, as shown by the difficulty of passing a probe downward from the opening compared with that of passing a probe upward from the opening.

The anomalous vein in this case was the left innominate. This vein normally is situated posterior to the thymus and joins the right innominate to form the superior vena cava just above the bifurcation of the trachea. In this case the vein extended anterior to the gland and lay in a groove on its anterior surface.

This condition is not common, judging from the number of reports in the literature (41). K. Hart reports a similar case in which the thymus was normal in size. V. Mettenheimer (42) also reports such a case and thinks there may have been compression between the gland and the sternum. Forret (43) and Dwornitschenko (44) each report a case. L. Rehn, in commenting on V. Mettenheimer's case, thinks that the vein came to be anterior to the gland by causing pressure atrophy of the gland substance and cutting through from the posterior to the anterior side of the gland.

Kayser (45) found a carotid extending over a prolongation of the thymus in the anterior surface of which it had cut a groove and the thymus tissue had been replaced by scar-tissue.

The prolongation of the upper lobes of the thymus into the neck is considered anomalous by some authors and not by others. Thus L. S. Dugeon says "The main portion of the gland is situated within the thorax but both lobes send prolongations upward for a short distance into the neck, sometimes reaching to the thyroid." Reiffel and LeMeé (46) in 34

cases found the thymus extending to the thyroid in one-fifth of the cases.

Weber (47) and Kuersteiner (48) found the prolongation of the right lobe most common, while Winslow and Cruchet (49) found the left lobe most frequently involved. The latter found this condition present in 10 out of 59 cases and says the thymus tissue is often represented by a fibrous band. Piersol (50) calls this band a suspensory ligament. In some cases, N. B. Harmon, the gland tissue extends along the great vessels to the root of the tongue and bifurcation of the carotid. G. Bien (51) cites cases in which the gland tissue was intimately associated with the vagi nerves.

A. Hammar on the other hand says that any elongation of either pole of the thymus is an anomaly and represents a reversion to the type seen normally in the lower animals, especially birds and reptiles.

This article is necessarily not exhaustive. It is an attempt on the part of the writer to assemble and correlate the work of a great number of men who have worked on various phases of the subject so that we may have a clearer idea of the subject as a whole as it presents itself to the clinician. I should like to point out the great need in future work along this line of complete data. Each case should be investigated exhaustively from the standpoint of anatomy, pathology, and histology of the thymus and the possible changes in other glands and tissues of the body noted. Such data together with careful clinical notes and history subsequent to operation will greatly assist in clarifying this interesting field.

The condition is not difficult of recognition clinically for one who is familiar with its signs and symptoms.

Operation with removal of a portion of the gland is of benefit in the cases of pure status thymicus which are accompanied by severe pressure symptoms.

Tracheotomy and intubation are of little value in most cases because the compression of the trachea is too low down.

The possibility of aberrant vessels, as in the case here reported, should be kept in mind by the surgeon to avoid injury to the same.

As to the advisability of and the benefits to be derived from operation on the thymus in cases of status lymphaticus with enlarged thymus, it is very doubtful if the operation should be undertaken except in the cases in which there is severe tracheostenosis.

BIBLIOGRAPHY

- 1 DUGON, L. S. J Path & Bact, x, 174
- 2 COPLIN, W M L. Publications from The Jefferson Med Coll & Hosp, 1915, vi, 116
- 3 HARMON, N B. J Anat & Physiol, xxxvi
- 4 JACOBI, Tr Ass Am Phys, 1911, xxvi, 353
- 5 REIN, L. Arch f klin Med, 1906, lxxx, 468
- 6 HAMMAR, A. Ergebn d Anat u Entwickel, 1909, xix, 1
- 7 STOEHR, Anat Hefte, 1906, xxxi, 409
- 8 MAXIMOW, Arch f mikr Anat, 1909, Nos 70 and 74
- 9 JOYSON, Arch f mikr Anat, 1909, lxxvii, 390
- 10 RIBADEAU and WEIL. Bull et mém Soc med de bôp de Par, 1912, xxvii, 431
- 11 BASCH, Jahrb f Kinderh, 1908, lxxx
- 12 MATTH, H. Mitt a d Grenzgeb d Med u Chir, 1912, xxiv, 663
- 13 WENSLow. Exposition anatomique de la structure du corpe humain. Amsterdam 1732
- 14 KATZ, Progrès méd, 1900, xlii, 385
- 15 BOURNEVILLE, Progrès méd, 1900, xlii, 380
- 16 KLOSE and VOGT. Klinik u Biologie der Thymus druese. Tuebingen 1910
- 17 KOENIG, Zentralbl f Chir, 1897, xvi
- 18 HEINRICH, Inaugural Dissertation, Leipzig, 1907
- 19 COHN, Hans. Deutsch med Wchnschr, 1901
- 20 LANGE, Verhandl d Gesellsch f Kinderh, Kailb, bad, 1902, Dec 19
- 21 ZANDER and KEHL, Ibid
- 22 CAILLÉ, Arch Ped, N Y, 1903, xi, 180
- 23 WIESEL, Arch f path Anat, 1904, clxxvi, 103
- 24 HEDINGER, Jahrb f Kinderh, 1906, lxxx.
- 25 PALTAUF, A. Wien. klin Wchnschr, 1889, xlvii, 1908, li.
- 26 FRIEDLEBEY, Die Physiologie der Thymusdruese. Frankfurt 1838
- 27 VICHOW, Die Krankhaften Geschwuelste. Berlin 1865, ii
- 28 COHNHEIM, Allgemeine Pathologie 1880, li
- 29 BROUARDEL, Death and Sudden Death
- 30 HALSTEAD, W S. Bull Johns Hopkins Hosp, 1914, xiv, 232
- 31 GARRE, XL Cong d deutsch Gesellsch f Chir, 1911.
- 32 VON HABERER, Mittl a d Grenzgeb d Med u Chir, xxvii, 270
- 33 FALTA, The Ductless Glandular Diseases. Philadelphia 1915
- 34 PARK, E A, and MCGUIRE, W C. Arch Int Med, 1914, x, 214
- 35 BOGGS, Tr Ass Am Phys, 1911, xxvi, 353
- 36 EMERSON, Arch Int Med, 1914, xiii, 174
- 37 FRIEDLANDER, Arch Ped, N Y, 1907, xxiv, 490
- 38 MAYERS, Arch Ped, N Y, 1908, xxv, 607
- 39 RACHFORD, Am J M Sc, 1910, cxi, 550
- 40 SCHEELE, Ztschr f klin Med, vol xvi, Suppl
- 41 HART, K. Mittl a d Grenzgeb d Med u Chir, 1909, xii, 371
- 42 METTENHEIMER, V. Jahrb f Kinderh, 1897, 655
- 43 FORRET, Thèses de doct, Par, 1896
- 44 DWORNTSCHENKO, Viertel f ger Med, 1897, xiv.
- 45 KAYSER, Inaugural Dissertation, Giessen, 1895
- 46 REIFFEL, H, and LEVIZÉ, J. Comp Rend. Acad d. Sc, Par, 1909, 148
- 47 WEBER, Hildebrand's Handbuch der Anat des Mensch, 191
- 48 KUESTER, W. Anat Hefte, 1899, vol u
- 49 CRUCHIER, R. Bull et mém Soc anat, Par, 1901, lxxvi
- 50 PLEASOL, Human Anatomy, 1911, p 1797
- 51 G BIEN, Anat Anz, vol xxx
- 52 VEAQ and OLIVIER, Presse méd, 1910, xxvii, 257
- 53 PARKER, C V. Am J Dis of Child, 1913, v, 89

UTERINE HÆMORRHAGES

WITH SPECIAL REFERENCE TO ACTINOTHERAPY

By HENRY SCHMITZ, A M, M D, F A C S, CHICAGO

GENERAL CONSIDERATIONS

THERE are two kinds of uterine hæmorrhage the one which is periodical and associated with the menses is termed menorrhagia (monthly bleeding), the other occurring at irregular intervals and independent of the menstrual flow is known as metrorrhagia (uterine bleeding). The two conditions may be easily differentiated or it may not be possible to discriminate one from the other. But this is not of any clinical importance, as the one may be a degree of the other and we may term both "uterine hæmorrhage." Whether the men-

strual flow is too profuse, lasts too long, or is too frequent should be determined by a careful interrogation of the patient, taking into consideration the number of napkins used, the character of the blood (whether arterial or coagulated), the duration of the flow, and finally the determination of the onset of each hæmorrhage.

ETIOLOGY

The causes of uterine hæmorrhage are (1) accidents of pregnancy, labor, and puerperium, (2) functional derangements of the genital organs without any demonstrable

Case No.	Name	Age	Sex	Para	Duration of Hemorrhage	Diagnosis	Date of Treatment	Kind of Treatment	Immediate Result	Remote Result
10	Mrs. G.	36	M	V	Ten years	Myometrial sterc	June 15, 1912	X-ray 200 X	Amenorrhea	Nov. 30, 1912, change of line. Well. Mild
11	Mrs. A.	40	M	0	Four years	Myometrial sterc	Jan. 20, 1914	X-ray 200 X	Amenorrhea	Dec. 4, 1913, Well. Strongly
12	Mrs. Y.	45	M	I	4 years	Hypertrophic sterc	Dec. 1, 1913	X-ray 200 X	Amenorrhea	Nov. 1, 1913, Well. Mild clims
13	Mrs. G.	43	M	V	Three years	Myometrial sterc	April 15, 1914	X-ray 200 X	Amenorrhea	Nov. 1, 1913, Well. Mild clims
14	Mrs. M.	35	S	0	Several years	Myometrial sterc	June 25, 1913	X-ray 200 X	Amenorrhea	Nov. 11, 1913, Well. Mild
15	Mrs. K.	45	M	IV	Eight years	Hypertrophic sterc	May 15, 1914	X-ray 200 X	Amenorrhea	Nov. 1, 1913, Well. Several clims
16	Mrs. N.	41	M	III	Four months	Hypertrophic sterc	Sept. 11, 1914	Radium 1200 mch.	Amenorrhea	Well. Mild clims
17	Mrs. P.	38	M	0	6 months	Myometrial sterc	Oct. 15, 1914	Radium 1200 mch.	Amenorrhea	Nov. 1, 1913, Well. Tumor removed from abd. is hard to touch.
18	Mrs. L.	35	M	IV	One year	Metropathia haemorrhagica	Nov. 4, 1913	Radium 1200 mch.	Amenorrhea	Nov. 1, 1913, delivered of normal child at 32 term
19	Mrs. R.	30	M	VI	5 years	Myometrial sterc	Dec. 7, 1914	Radium 2000 mch.	Amenorrhea	Well. Very mild clims
20	Mrs. M. L. C.	30	M	I	Three months	Myometrial sterc	Feb. 15, 1915	Radium 1250 mch.	Hemorrhages continued	Mar. 2, 1915, Hemorrhages continued
21	Mrs. F.	41	S	0	Three months	Hypertrophic sterc	Mar. 2, 1915	Radium 1250 mch.	Amenorrhea	Nov. 11, 1915, complete Amenorrhea. Uterus normal
22	Mrs. C.	30	S	0	Several years	Metropathia haemorrhagica	April 8, 1915	Radium 1200 mch.	Amenorrhea	Dec. 1, 1915, Well. Very mild clims
23	Mrs. P.	35	M	III	Two years	Myometrial sterc	Feb. 15, 1915	Radium 1250 mch.	Amenorrhea	Well. Average clims
24	Mrs. B.	45	M	V	Ten years	Myometrial sterc	May 4, 1915	Radium 1200 mch.	Amenorrhea	Died Nov. 12, 1915, after years' suffering but had some relief of symptoms. Uterus but slightly enlarged. Tumor almost gone.
25	Mrs. P.	40	M	0	One year	Myometrial sterc	May 21, 1915	Radium 1200 mch.	Practically cured	Uterus practically normal
26	Mrs. D.	41	M	III	Three years	Myometrial sterc	June 20, 1915	Radium 1200 mch.	Amenorrhea	One polypoid mass removed. Nov. 1, 1915
27	Mrs. A.	38	M	IV	Eight years	Hypertrophic sterc	Oct. 8, 1915	Radium 1200 mch.	Amenorrhea	Dec. 6, 1915, Amenorrhea

pathology, (3) diseases of the generative organs with a demonstrable pathology, (4) general constitutional or systemic diseases, and (5) vascular disturbances.

The accidents of pregnancy, labor and puerperium belong to the domain of obstetrics and will not be considered in this paper. Such disturbances are abortions, either threatened or incomplete, extra uterine pregnancy, placenta previa, premature detachment of the placenta, atony of the uterus during or following the puerperal stage of labor, injuries of the uterus, retained oval membranes, subinvolution, etc. If a uterine prosthesis unexpectedly occurs in a married woman, the

possibility of an abortion or extra uterine gestation should always be considered.

The functional disturbances of the genital organs depend in all probability on a dysfunction of the internal secretion of the ovaries and other ductless glands. We know from animal experimentation and clinical observation that hormones of certain ductless glands either inhibit or stimulate ovarian internal secretion; for instance hyperpituitarism causes amenorrhea and finally sterility and atrophy of the genital organs. Hyperthyroidism is usually accompanied by amenorrhea, while hypothyroidism is often associated with uterine hemorrhages. In other words, in

creased activity of the thyroid gland leads to a decreased activity of the internal secretion of the ovary, and decreased thyroid gland activity results in an hyperfunction of the ovary.

The diseases of the uterus and adnexa accompanied by uterine hæmorrhages are: (1) *Circulatory disturbances* resulting in a hyperplasia of the genital organs. They are brought about by (a) trauma and subsequent scar formation, as lacerations of the cervix, inflammatory cicatrices from necrosis and gangrene, hæmatoma, and hæmatocele; (b) displacements and deformities, as flexions, versions, rotations, torsions, inversion, prolapse, and hernia formation, (c) tumors, leading to an obstruction of the blood and lymph circulation; (d) obstinate and habitual constipation; and (e) active hyperæmia from perversions of sexual and marital life. (2) *Inflammations* of the pelvic organs as gonorrhœal, septic, and tuberculous infection. (3) *New-growths* of the uterus as carcinoma, sarcoma, chorio-epithelioma, myoma, and adenomyoma.

General constitutional or systemic diseases are the anæmias (while chlorosis causes oligomenorrhœa or amenorrhœa), chronic poisonings, as lead, alcohol, and phosphorous poisoning, acute infectious diseases, as cholera, smallpox, malaria, typhoid, and scarlet fever, also scurvy, rheumatoid diathesis and hæmophilia.

Vascular disturbances are the result of chronic cardiac, hepatic, and nephritic disease.

Out of 643 consecutive gynecological cases that came under my observation at the St. Mary's (199) and Willard (444) hospitals, 135 or 21 per cent were accompanied by uterine hæmorrhage due to an underlying genital disease. The diseases associated with uterine hæmorrhage are

Carcinoma uteri	19 cases or 14.1 per cent
Chronic adnexitis	16 cases or 11.8 per cent
Hyperplasia of the endometrium	13 cases or 9.7 per cent
Myomata uteri	11 cases or 8.1 per cent
Hyperplasia of myometrium	11 cases or 8.1 per cent
Retroflexio uteri	11 cases or 8.1 per cent
Abortion	10 cases or 7.4 per cent
Descensus uteri	9 cases or 6.7 per cent
Oophoritis and ovarian tumors	8 cases or 5.9 per cent
Chronic cervicitis with lacerations	6 cases or 4.4 per cent
Hæmorrhagic metropathy	6 cases or 4.4 per cent

Extra uterine pregnancy	5 cases or 3.7 per cent
Endometritis post abortum	4 cases or 3.0 per cent
Subinvolution of uterus	4 cases or 3.0 per cent
Sarcoma uteri	2 cases or 1.5 per cent

Fifty-six out of these 135 cases are characterized by a proliferation of uterine tissue. Thirty-two or more than one-half of the 56 are caused by new-growths and of these 19 are the result of carcinomatous formations. If we add to these 56 cases the 6 cases of hæmorrhagic metropathy or essential hæmorrhages, we obtain a total of 62 cases which formerly indicated repeated curettages and finally hysterectomies to relieve the patient. The cancers and myomata, of course, were always extirpated if operable.

DIAGNOSIS

A correct diagnosis of the underlying disease in uterine hæmorrhages is of the utmost importance. It can only be rendered by a microscopic examination of the endometrium or excised pieces of uterine tissue. A careful general and special pelvic examination will be a valuable adjunct. Carelessness in diagnosis leads to procrastination which has often changed a favorable into a hopeless prognosis. Incipient malignancy can only be recognized in this manner. At this stage the malignancy is localized and can be easily and completely eradicated, and an anatomical cure is thus assured.

TREATMENT

It is not my object to discuss the treatment of the immediate arrest of uterine hæmorrhages at the time of their occurrence or describe the technique of a curettage or of a hysterectomy. The purpose of this study is to call your attention to the curative action of actinotherapy or radiotherapy in treating uterine hæmorrhage. If we subtract from the 62 cases mentioned above the 21 cases of malignancy, we have left 41 cases of uterine hæmorrhage which had existed for a long period of time and resisted all usual treatment. Formerly the majority of these women had to be hysterectomized to bring about a cessation of the hæmorrhage. Six patients were treated with the massive roentgen rays and 12 with radium. The accompanying table gives all the data necessary.

Technique A course of X-ray treatment consists of 6 sances each of about one hour's duration, given on six succeeding days. Water-cooled tubes of a diameter of 7 inches and a hardness of 7 to 9 Heinz Bauer are charged with a current of 2 to 3 milliampères. The focal distance of the tube from the patient is 21 cm. The rays are filtered through an aluminum plate of 3 mm thickness. Six different fields, each 5 cm square, are drawn upon the suprapubic region. Thirty to forty X are applied to each field. The amount of X used is determined by a Holznecht radiometer. The applications are preferably made during the week following the cessation of menstruation. Usually one such course of treatment suffices to produce amenorrhœa. If this should not occur, a second course is given after three weeks, which invariably brings about the desired result. Concomitant symptoms are mild. They usually consist of nausea or diarrhœa, but are of a transient nature.

Only the γ rays of radium are employed in the treatment of uterine hæmorrhages. The α and β -rays are arrested by a lead filter of the thickness of 2 mm, the secondary or Sagnac rays, forming in the heavy metal filter, which resemble the soft β rays of radium, are absorbed by a pure para rubber filter of 1 mm thickness. The average amount of milligram hours of radium element necessary to cause amenorrhœa is 1,000. If 50 milligrams of radium element are employed, it will take twenty hours to obtain this milligramage. The patient is prepared as for any operation. One quarter of a grain of morphine is given hyperdermically about one half hour prior to the time the application is to be made. The field around the vagina is rendered sterile, the cervical canal dilated, the endometrium is curetted for diagnostic purposes, and the radium capsule is then placed in the uterine cavity. A small chain or silk thread is left

attached to the capsule to facilitate its removal. On an average 1,000 milligram hours suffice to bring about amenorrhœa. If the patient should still flow at a subsequent period, the application may be repeated after four to six weeks.

I repeat the necessity of a diagnostic curettage to exclude malignancy before the treatment with the roentgen or radium rays is begun.

The indications for this treatment followed by me are as follows. Essential uterine hæmorrhages and hyperplasia of endometrium and myometrium. In a patient of 35 years or older, failure of medicinal and local mechanical treatment to bring about cessation of the hæmorrhages. If repeated curettages in women below 35 years of age do not result in a cure, then actinotherapy is also indicated.

Myomata uteri Myomata of the cervical submucous or pedunculated varieties and myomata undergoing degenerations must be treated surgically. Women below 35 years of age desiring off-spring are myomectomized. All other myomata are subjected to actinotherapy, which invariably causes amenorrhœa. The tumor decreases in size and often disappears entirely.

Radium is preferable to the X-ray. Radium destroys the endometrium, the roentgen ray causes a cessation of ovarian activity. The symptoms of change of life are, therefore, mild after the former treatment, while they are very pronounced after the roentgen treatment. The latter requires much more time for its application and is more expensive than the use of radium which necessitates an interruption of the daily routine of the patient for only twenty-four hours. Both methods, when properly used, are devoid of danger. Should contra indications to surgical measures exist, as heart disease, general constitutional disease, etc., actinotherapy can still be safely and successfully employed.

PYELITIS OF PREGNANCY, WITH ESPECIAL REFERENCE TO ITS ETIOLOGY¹

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THE first description of this infection seems to have appeared in Smellie's *Midwifery*, in 1752. Rayer described it in detail in 1842. Until quite recently, the condition did not attract the attention which its frequency and importance demand. Reblaub reopened the subject in 1892, reporting several cases and discussing the treatment. Since the publication of his article there have appeared a number of papers on the subject. The frequency with which infection of the pelvis of the kidney, and even of the kidney parenchyma, occurs, and the danger which its appearance often brings with it, are not yet generally appreciated. Undoubtedly many cases are entirely unrecognized, and every one who has had much obstetrical experience is aware of instances in which it has been confused with appendicitis, or has seen cases of rise of temperature in the puerperium which have been looked upon as puerperal fever, but which in reality have been infections of the kidney. Careful examination of the urine, coupled with painstaking physical examination, will almost invariably make it possible to differentiate infections of the kidney from either of these.

Considerable difference of opinion has existed among those who have written upon the subject as to the exact pathogenesis of the disease. Some writers have held the view that the infection is an ascending one originating in the bladder and traveling up the ureter either within its lumen or by way of its lymphatic channels. Another and considerably larger group believe that the infection is a blood borne one. Certain mechanical and anatomic factors are to be considered. The infection is, with rare exceptions, right sided. This is explained by the fact that the right ureter is pressed upon at the brim of the pelvis by the pregnant uterus which often inclines to the right. The uterus, as it rises out of

the pelvis, passes before the mesentery and is deflected toward the right side. The same factor also, in a measure, protects the left ureter from pressure. Mirabeaux believes that the proximity of the ascending colon to the more freely movable right kidney has an influence upon determining the frequency of right-sided infections. While most authors affirm the possibility of mechanical obstruction being produced by the pregnant uterus pressing upon the ureter, a recent textbook rather scouts this theory, the author believing that kinks or bends in the ureter, rather than pressure, produce the obstruction. He bases this view upon the fact that the specific gravity of the pregnant uterus and that of the other abdominal contents are the same, and that therefore obstructive pressure would not be possible. That mechanical obstruction of the ureter is an undoubted fact, would be demonstrated by the following observation made upon a case seen through the courtesy of Dr. W. G. Alexander.

The woman was four months pregnant. She had a right sided pyelitis, and pus with little or no epithelium had been found in her urine by her physician. At the time she was seen, she had severe pain over the right kidney, and, shortly before my examination, the urine has been found to contain no pus. She was cystoscoped and an attempt made to collect the urines separately. The catheter passed up the left ureter easily and perfectly clear urine began immediately to flow. The catheter passed into the right ureter and ascended about ten centimeters from the bladder, when it stopped and could not be passed farther. The patient was then turned upon the left side in order to permit the uterus to gravitate away from the ureter, when the catheter passed upward to the kidney pelvis without the least difficulty and turbid urine began at once to flow. It did not flow intermittently, as is usual when the kidney pelvis is not distended, but came steadily and rapidly until a large test tube was filled. There was, therefore, certainly a distended kidney pelvis, and, if the obstruction would not allow the catheter to pass upward, it certainly would be sufficient to keep urine

¹Inaugural Thesis presented before the Chicago Gynecological Society, January 31, 1915. (See p. 723 for discussion.)

from flowing down. Further, after the kidney pelvis had been drained through the catheter, the pain in the back on the right side disappeared and the patient stated that she was more comfortable than she had been for some time. Cultures which were made from the urine obtained from this case will be referred to later.

Crew reports a case in which abdominal pain, vomiting, fever, rapid pulse, and chills were present, but in which no pus appeared in the urine until abortion followed an exploratory laparotomy. The appearance of pus permitted a diagnosis of pyelitis to be made, this condition for some reason not having occurred to the examiner earlier. The ureter in this case evidently was obstructed by the uterus, the obstruction, which had not been recognized, being removed when the uterus was emptied.

All observers in this field agree that the bacillus coli is the almost invariable infecting organism. Other organisms, such as the streptococcus, staphylococcus, gonococcus, and even the tubercle bacillus have in infrequent cases been observed.

In order to determine what relation might exist between the bacteria present in the bladders of normal pregnant women and the pyelitis of pregnancy, the following observations were undertaken:

The urine was obtained from the bladders of normal gravidæ upon entering the hospital. The meatus urinarius was carefully sponged off not less than six times with pledgets wet with one per cent lysol. The urine was received in a sterile bottle protected by a sterile cotton stopper. The catheter was passed by a nurse who had made complete surgical preparation of her hands. Such specimens were obtained from fifty women. The urine was put through the usual clinical laboratory tests in order to determine its freedom from any evidence of pathologic conditions. A portion was then centrifuged in a sterile centrifuge tube and the sediment inoculated upon blood serum culture tubes. Of these fifty cultures thirty-two showed a pure growth of staphylococcus. Two showed a pure culture of colon bacillus. Three gave a growth of colon bacillus and staphylococcus, while thirteen gave no growth. Colon bacil-

lus, therefore, was found in pure culture, or mixed with staphylococcus in five cases.

A further and more careful investigation was made covering fourteen additional cases in order to ascertain by more exact cultural methods whether the colon bacillus could not be more frequently found. These women were all catheterized after a complete surgical preparation for delivery, or after having been taken to the labor room. These specimens were for the most part obtained by a superintending nurse concerning whose asepsis there can be no question. A few were secured by the writer in the labor room after preparation and before any possible break of asepsis could have been caused by the restlessness of the patient. The meatus was wiped with a succession of ten separate pledgets soaked in one per cent lysol. The urine was received in a series of three test tubes which had been autoclaved and provided with cotton stoppers. These were examined chemically and microscopically, the findings in all cases being within the range of the normal. The first two tubes were discarded for cultural purposes, the last of the three only being used. Cultures were made as follows. Two tubes of agar were melted in the water bath and cooled. To one was added two cubic centimeters of human ascitic fluid, and after cooling to a temperature of 43°C , two cubic centimeters of urine was added with a sterile pipette and the mixture plated. To the other tube of melted agar was added, at the temperature of 43°C , two cubic centimeters of urine, and the mixture shaken and allowed to cool. In an agar slant to which had been added human ascitic fluid and goat's blood, the latter in order that hæmoglobin might not be absent, was placed two cubic centimeters of urine. From this culture tube, oxygen was removed by means of pyrogallic acid and sodium hydrate to permit the growth of anaerobic organisms.

Eight of these cultures gave a pure growth of the staphylococcus, two of them upon the ascites agar plate and four in the agar shake culture. These colonies were transferred to blood agar slants in order to verify the examination of the plate colonies. All transfer cultures from these plates gave pure

growth of staphylococcus All were gram stained Four urines were negative in all three cultures One urine gave negative results in the ascites agar plate, and agar shake culture, but a slow growing organism appeared upon the surface of the anaerobic blood agar slant On the eleventh day after inoculation a smear was made from this tube and small coccus-like bodies found, which stained by gram, but were not recognizable A transfer culture was made upon an aerobic blood ascites agar slant and after three days a smear showed a pure growth of pseudodiphtheria No anaerobic cultures or agar shake tubes were considered sterile until ten days had elapsed without growth

In one case there appeared no growth upon the agar plate and none in the agar shake. An aerobic blood agar slant showed an abundant gray, solid growth This organism was a spore forming bacillus about the size of the diphtheria bacillus It grew very slowly anaerobically A culture upon a blood agar slant showed marked hemolysis in 24 hours which was more pronounced in 48 hours A 24 hour culture in bouillon showed the organism to be slightly motile A gram-stained preparation 24 hours old showed the organism irregularly arranged upon the slide, with slight tendency to chain formation Spores were present in both ends of most of the organisms in this preparation A smaller number showed but one spore in the middle of the organism A gram stained preparation from a 48 hour growth showed the same appearance of the individual organism, but a rather greater tendency to chain formation

Cultures were made upon the following media with the accompanying cultural reactions lactose litmus agar, no reaction, mannit litmus agar no reaction, litmus milk, no reaction, dextrose litmus agar, a distinct red color after 24 hours, showing that in this medium the organism has an acid reaction

This organism is in all probability not a pathogenic one, inasmuch as the woman from whose urine it was obtained was a perfectly healthy gravida who subsequently within twelve hours had an entirely normal labor which was followed by an uneventful puerperium It must also have been present in

very small numbers, for in only one of the four original cultures which were made from this case did it appear. If it had been present in any numbers, it must have appeared in the agar-shake culture and should have shown upon the agar ascites plate. It must probably be, therefore, looked upon as a chance finding. But its description and cultural reactions are included in order that comparison may be made by others who may be doing similar work. The bacteriology of the urine both in pregnancy and in other states is as yet by no means fully worked out.

In the second series of fourteen cultures there were found staphylococci in seven cases. One case gave a growth of pseudodiphtheria, and one case gave a growth of a spore-forming bacillus positive to gram stain, motile, and having an acid reaction in dextrose-agar growth, showing no reaction in lactose agar, mannit agar, and litmus milk. In a series of sixty-four cultures, therefore, colon bacillus was found five times, which is considerably less frequently than has previously been reported These five cases all occurred in the first series, none of them having occurred in the second series of much more carefully worked out cases It may be justly questioned whether some contamination may not have occurred in the first series.

I have had the opportunity of obtaining specimens of urine by means of the ureteral catheter from two cases of pyelitis of pregnancy. Both of these cases gave a pure growth of colon bacillus In one of these cases, the cultural reactions of the organism were worked out by the writer and were typical of the colon bacillus In the other case, the same work was done by the pathologist of the hospital with a similar result These two cases were therefore beyond question colon bacillus infections

It is highly probable that the staphylococcus, which is so frequently found in the urine of gravidæ, is an organism of a very low degree of virulence None of the women from whom these specimens were obtained showed any symptoms of trouble referable to the urinary tract, all women seeming to be other than entirely normal being excluded It is probable, however, that these organisms did exist in the

bladder and did not come from the urethra, as the first portions of the urine contained in the first two tubes of the last series of fourteen cases, would, in passing through the catheter, wash away any infective material which might be deposited in the eye of the catheter while introducing it. The staphylococcus must, therefore, be looked upon as a frequent inhabitant of the bladders of pregnant women, but also as a relatively harmless one. I intend at a later date to inoculate some of these organisms into laboratory animals with a view to determining their virulence.

Loeppritz, in 1911, in a series of experiments upon the urine of pregnant women, has endeavored to show that two factors exist which give to the urine of pregnant women a certain degree of antiseptic power. First, its normal acidity, and second, a leucocytic bactericidal substance which may be destroyed by heating to 90° C. This substance exercises a decided influence upon the growth of staphylococcus and streptococcus, but affects the colon bacillus but little. This if true affords an additional explanation of the very low grade of virulence of the staphylococci so frequently found in the urinary tracts of gravidæ.

It has been suggested that the most exact cultural results might be secured by obtaining specimens from the bladder by means of a needle passed through the anterior vaginal wall in a spot which had previously been touched with iodine. I do not agree with this, for I do not see how contamination with Doederlein's bacillus, for example, or other vaginal flora may be entirely insured against. It can hardly be possible to eradicate all bacteria from the deeper portions of the mucosa any more than from the deeper layers of the skin by any form of surface antiseptics. I doubt whether it would be possible to obtain urine from the female bladder under any more effective precautions than were here used.

As to the question of the mode of entrance of the colon bacillus into the pelvis of the kidney, I believe that the infection is a blood-borne one. It has been urged that, as colon bacilli have not been found in the blood stream, the infection by this organism could

not be a blood borne one. Dick and Dick have shown that in nephritis of infective origin the organism causing the primary process may be recovered from the urine by cultural methods, although the blood culture may fail to demonstrate it in the blood stream. It is, therefore, possible for an organism to pass through the blood stream in numbers so small that cultural efforts to find it fail, and still grow secondarily in the kidney.

The distended and congested kidney which is found as a result of obstruction to the ureter forms a *locus minoris resistentiæ*, and colon bacilli which exist in enormous numbers in the large bowel may easily be deposited there by the blood stream.

Sieher experimented upon rabbits to determine whether an artificial obstruction to the ureter could influence the production of a pyelitis. He placed a loop of catgut in such a manner that it pulled upon but did not completely occlude the ureter. He then placed solutions of the animal's own feces in the bladder as well as irritating bodies, such as croton oil. His conclusion was that the infection was not an ascending one, although his previous view had been to the contrary.

While it cannot be assumed that the infection is invariably of hæmogenic origin, and I do not feel that I have proved that to be the case, I believe it may in the large majority of cases be looked upon as a blood borne infection. Recent work upon focal infections of various kinds and their transmission to distant parts of the body must cause us to believe that this mode of transmission is much more frequent than was formerly believed to be.

Much has been written upon the treatment of the pyelitis of pregnancy. Many cases will respond sufficiently to palliative treatment alone. Postural treatment is of great value. If the patient be kept upon the right side or upon the abdomen the uterus will gravitate away from the right ureter, thereby allowing the kidney to drain. With this may be combined water in large amounts and hexamethylenamine in amounts sufficient to give a reaction for formaldehyde in the urine. If relief is not had within a short time, further means of combating the infection must be thought of.

Vaccines have proved to be disappointing. Certainly while obstruction exists no great result can logically be hoped for from their use. My experience with them has been limited and confined exclusively to the use of autogenous vaccines given after delivery or after the uterus has been emptied. As in such cases recovery usually follows spontaneously, it cannot be assumed that the vaccines were wholly or even in large part responsible for cure.

The ureter catheter is a valuable aid. Textbooks, as a rule, merely mention it. But a large number of European writers recommend it as of great value. By ureteral catheterization, a distended kidney pelvis may be drained and pain thereby greatly relieved. And in severe and stubborn cases the kidney pelvis may be irrigated and solutions of silver nitrate or other antiseptics instilled. This procedure may, if necessary, be repeated a number of times. Cystoscopy is, as a rule, not difficult in a pregnant woman, especially in the first half of pregnancy. It should however, be carried out with great caution, the instrument being introduced with the greatest possible gentleness, as cases of abortion after it are not unknown. The Kelly instrument cannot be used, as in pregnancy the knee chest position is impossible on account of the large uterus falling forward upon the bladder. With a water instrument carefully used it may be successfully carried out. In cases in which, for any reason the diagnosis is in doubt, this procedure will clearly demonstrate whether the kidney is at fault, and at the same time offers a means for at least temporary relief. It should not be used until postural treatment and the use of urinary antiseptics have failed.

If the infection advances to such a degree that the integrity of the renal parenchyma is believed to be in danger, more radical means must be considered. The induction of labor must in infrequent cases be resorted to. In the endeavor to escape this radical and unwelcome operation, a number of authors have tried and recommend nephrotomy. This has been done during pregnancy successfully by several writers, notably Opitz, Legu, Kehr, McDonald, C. P. Davis, and Cova

Davis reports three such cases. If necessary, a nephrectomy may be done later, but in several of these cases the renal fistula is said to have closed after delivery. In cases of severe infection in which the kidney has undergone irreparable damage, nephrectomy may be carried out during pregnancy. Cova reports twenty-three cases in which this operation was done during pregnancy successfully. In thirteen of these cases subsequent pregnancies occurred. It seems scarcely possible that such a procedure should be necessary or justifiable in a case which had been under competent observation from the start. In cases which are first seen after the development of a severe pyelonephritis it is conceivable that nephrectomy might be a necessary and justifiable procedure. My own view is that in cases in which the kidney seems likely to undergo damage sufficient in degree to render later nephrectomy necessary would present a reasonable indication for the induction of labor. One should consider carefully before allowing the infection to proceed, in a case which is seen early, to a point at which sacrifice of the kidney would be necessary.

Nephrotomy may be much more lightly undertaken, for here the kidney is preserved with a high degree of likelihood of its later resuming full functional activity. Barth believes that nephrotomy is preferable to induction of labor, and there is at least some justification for his view. But the extreme view of Stocckel, that induction of labor is never necessary, can scarcely be supported, and is not concurred in by the majority of writers.

By far the most important thing in the treatment of this infection is its early recognition. And this depends upon careful observation and urine analysis on the part of the physician. If pyelitis be early recognized and the treatment be instituted immediately, a great majority of cases may be successfully carried through.

BIBLIOGRAPHY

- ADAMSON, R. O. Pyelonephritis complicating the puerperium. *Tr. Glasgow Obst. & Gynec. Soc.*, 1906, Feb 23 v. 190
 ALBARRAN Les signes et le traitement de la pyélonéphrite gravidique. *Jahresb. f. Geburtsh. u. Gynack.*, 1907, p. 324

- ANCART, G. Un caso di pielonefrite in gravidanza. Gazz med, Sicily, 1917, xvi, 351.
- ANDREWS, A H. An address on pyelonephritis of pregnancy. Brit M J, 1912, i, 1112.
- ASCHARD and FEUILLÉ. Pyélonéphrite gravidique terminée par urémie rapidement mortelle. Soc. méd. d'hôp. Seance, 1912, p. 22.
- BARTH. Ueber Nierenentzündungen in der Schwangerschaft. Ztschr. f. Chir., 1906, lxxiv, 57.
- BAZY and TUFFIER. Apopros de pyélonéphrites gravidiques. Bull. et mém. Soc. de chir. de Par., 1910, xxxvi, 826.
- BOYNAIRE and LEVANT. Pyélonéphrite au 5^e mois de la grossesse, avortement, bactérienne sans pyurie. Bull. Soc. d'obst. de Par., 1911, xiv, 423.
- BONNEAU. De la compression des ureters par l'utérus gravide et des pyélonéphroses consécutives. Thèse de doct., Par., 1893.
- BRONCKEMA, H. De behandeling van pyelitis bij zwangren. Nederl. Tijdschr. v. Geneesk., 1913, i, 599.
- BRUCE BAYS, J. Pyelonephritis of pregnancy. South African M. Rec., 1913, vii, 216.
- BURTON, A. W. Acute pyelitis complicating pregnancy and simulating acute abdominal disease. South African M. Rec., 1914, xii, 403.
- CATHALA. Pathogénie et étude clinique de la pyélonéphrite gravidique. Obstétrique, 1905, x, 165.
- CATHALA and JEANIN. Double pyélonéphrite gravidique supportée à colibacilles. Obstétrique, 1905, x, 521.
- CATELAIN, F. La pielonefritis llamada del embarazo. Arch. de ginec., 1914, xxvii, 1.
- CATELAIN, F. La pyélonéphrite dite de la grossesse. Monde méd., Par., 1913, xxxii, 533.
- CHANCE, A. E. Pyelitis of pregnancy. J. Am. M. Ass., 1911, lvi, 38.
- CHALFARD. Pyélonéphritis gravidiques. Rev. gén. de clin. et de therap., 1913, xxvii, 533.
- COCHRANE, F. L. Pyelitis of pregnancy. Internat. J. Surg., 1910, xxiii, 194.
- COVA. Nefrectomia e gravidanza. Ann. di ostet. et ginec., 1903, xxv, 692.
- CREW, F. D. Acute pyelonephritis complicating pregnancy. Brit. M. J., 1912, i, 825.
- CUMSTON, C. G. Pyelonephritis of pregnancy. J. Obst. & Gynec. Brit. Emp., 1905, viii, 221. Boston M. & S. J., 1910, clix, 645.
- DOZEMERLEIN, T. J. Pyelitis gravidarum. J. Am. M. Ass., 1911, lvi, 199.
- DUDGEON, LEONARD S., ROSS, ATHOLE. Infections of the urinary tract due to bacillus coli and allied organisms. Ann. Surg., Phila., 1910, li, 355.
- ERLER, R. Ein Fall von linksseitiger Nierensystemic, kombiniert mit rechtsseitiger Graviditetspyelonephritis. Ztschr. f. gynae. Urol., 1913, iv, 51.
- EVANS, DAVID J. Pyelonephritis as a complication of pregnancy and the puerperal period. Montreal M. J., 1909, xxviii, 71, 208.
- FLEISCHHAUER, H. Zur Diagnose und Therapie der Pyelitis gravidarum. Ztschr. f. gynae. Urol., 1911, iii, 221. Bibliography.
- FRANZ, K. Pyelitis gravidarum. Berl. Lin. Wchnsch., 1914, lii, 1534.
- FRANZ, R. Die Nierenbeckenentzündung der Schwangeren. Med. Klin., 1915, xi, 179.
- FREUND, H. Indikation zur Einleitung der kuenstlichen Fruehgeburt bei Nephritis. Vereinsbl. d. pfälz. Aerzte, 1911, xxvii, 134.
- FROMME, F. Die Diagnostik und Therapie der Pyelitis bei Schwangeren und Woechnerinnen. Heilkunde, 1910, p. 117.
- GAFFARI, J. La pielonefrite in gravidanza. Riv. osp., 1912.
- GAUGE, OTTO. Ueber Pyelitis gravidarum. 1910.
- GER, C. Ein Beitrag zur Pyelonephritis gravidarum. Inaugural Dissertation, Bern, Zentralbl. f. Gynaek., 1913.
- GIUSTI, G. Contributo allo studio della pielonefrite in gravidanza. Ann. di ostet. et ginec., 1914, ii, 113.
- GLINDYING, B. Pyelitis in pregnancy, and ureteral catheterization. Arch. Middlesex Hosp., 1911, xxv, 21.
- GRAEFE, KARL. Ueber Pyelitis gravidarum. Heidelberg, 1912.
- GUEMYOT, M. PAUL. Deux cas de pyélonéphrite gravidique précoce, pris au début pour les menaces d'avortement. Bull. Soc. d'obst. de Par., 1905, viii, 202.
- GUZZONI. Un caso di pielonefrite in gravidanza. Ginecologia, 1912.
- HICKS, H. T. Pyelitis of pregnancy treated with colic vaccine. Brit. M. J., 1909, i, 203.
- HOURTOULE, V. Une observation de pyélonéphrite de la grossesse traitée par le cathétérisme urétéral, néphrectomie consecutive. J. d'urolog. méd. et chir., 1914, vi, 55.
- HUGEL, K. Indikation zur Einleitung der kuenstlichen Fruehgeburt bei Nephritis. Vereinsbl. d. pfälz. Aerzte, 1911, xxvii, 37.
- JAEGER, F. Die Bedeutung alter Pyelonephritiden fuer gynakologische Operationen. Ztschr. f. gynae. Urol., 1911, iii, 233.
- JONASSON, S. Sind bei schwangren Faellen von Swangerschaftspyelonephritis chirurgische oder obstetrische Eingriffe vorzunehmen? Ztschr. f. gynae. Urol., 1911, iii, 279.
- JORGENSEN WEDDE, DORA. Ueber Pyelitis gravidarum. Muenchen, 1912.
- KEENER, E. Ueber Pyelonephritis gravidarum. Ztschr. f. gynae. Urol., 1911, iii, 24.
- KERMAYER, F. Zur Beurteilung der Pyelonephritis bei Schwangeren. Ztschr. f. gynae. Urol., 1911, iii, 291.
- LE FUR, L. La pyélonéphrite de la grossesse. Paris chir., 1913, v, 105, 163.
- LEGUÉ. De la pyélonéphrite dans ses rapports avec la puerpéralité. Rev. de gynec. et de chir., 1904, viii, 431.
- LEGUÉ. Resultats éloignés d'une pyélonéphrite de la grossesse. Soc. d'obst. gynec. et ped., 1907, Nov. 11.
- LEPOUTRE, C. La pyélonéphrite des suites de couches. Rev. prat. d'obst. et de gynec., 1913, p. 140.
- LOURIA, L. Acute hamatogenous infection of the kidney and pyelitis of pregnancy, their medical treatment. N. Y. M. J., 1911, xciii, 1073, 1138.
- MACCARLANE, CATHERINE. Pyelonephritis of pregnancy. Woman's M. J., 1911, xxi, 189.
- MACCARLANE, W. D. Notes on case of pyelitis complicating pregnancy. Tr. Glasgow Obst. & Gynec. Soc., 1913, iv, 87.
- MANSFELD. Ueber Schwangerschaftspyeliden und ihre Behandlung. Mitt. a. d. H. Frauenklinik, vol. ii.
- MARKEUS, N. Zur Therapie der Pyelitis gravidarum. Berl. Lin. Wchnsch., 1911, xlviii, 757.
- MAVER, A. The relations of colon pyelitis to gestation. Muenchen med. Wchnsch., 1913, vi, 1479.
- MCDONALD, E. Pyelitis in pregnancy, its etiology and cystoscopic diagnosis. Am. Med., 1910, v, 621.
- MIRABEAU. Pyelitis of pregnancy (Schwangerschaftspyeliden). Arch. f. Gynaek., 1907, lxxxix, 465.
- MULLER, V. Ueber Pyelitis gravidarum. Inaugural Dissertation, Zurich, 1911.
- O'CONNOR, J. W. Pyelonephritis of pregnancy and the puerperium with a report of cases. Boston M. & S. J., 1912, cxliii, 657. Abstracted Internat. Abs. Surg., 1913, xvi, 192.

- OPITZ, E. Pyelonephritis gravidarum et puerperum. *Ztschr. f. Geburtsh. u. Gynaek.*, 1905, l, 209.
- PASTEAU, O. Considerations sur l'étiologie et le traitement de la pyélonéphrite gravidique. *Paris chir.*, 1913, v, 645.
- PAVLOFF, A. N. Pyelitis gravidarum. *J. akush. i jensk. bolez.*, St. Petersburg, 1912, xxvii, 1267.
- PESTALOZZA, L. La pielonefrite nello stato puerperale. *Ginecologia*, 1904, 1, 449.
- PESTALOZZA, L. La pielonefrite in gravidanza. *Riv. crit. de clin. med.*, 1900.
- PILCHER, P. M. Postural treatment and lavage of the renal pelvis for the relief of pyelitis of pregnancy. *Surg., Gynec. & Obst.*, 1910, x, 169.
- PINARD, P. Pyélonéphrite au cours de la grossesse. *Rev. gén. de clin. et de thérap.*, 1911, xxv, 134.
- POLLACK, K. Kritisch experimentelle Studien zur Klinik der puerperalen Eklampsie. *Leipzig*, 1904.
- PLECH, M. Pyélonéphrite et morte du fœtus. *Bull. Soc. d'obst. de Paris*, 1909, 32, 372.
- PITCH, P. De la légitimité de l'accouchement provoqué dans la pyélonéphrite gravidique. *Montpel. méd.*, 1910, xxv, 281.
- REBLAUB, Des infections du rein et du bassin consécutives à la compression de l'uretère par l'utérus gravid. *Cong. franc. de chir.*, 1892, vi, 116.
- REED, CHARLES B. Pyelonephritis of pregnancy. *Surg., Gynec. & Obst.*, 1907, iv, 106.
- ROSENZELD, S. I. Complications of pregnancy by pyelitis and pyelonephritis. *Vruch. Gaz.*, 1912, xix, 94.
- ROBINSON, B. Pyelitis gravidarum. *Verhandl. d. Gesellsch. deutsch. Naturf. u. Aerzte*, Königsberg, 1911, lxxxi, 2, 1911.
- ROSTOVSKY, Ueber Pyelitis gravidarum. *Muenchen med. Wchnschr.*, 1910, lxxvii, 2110.
- ROUTIN, C. L'acupuncture traitement de pyelonephritis in pregnancy. *Brit. M. J.*, 1910, i, 191.
- RUERSAMEN, W. Zur Behandlung der Pyelitis gravidarum mittels Nierenbeckenspülungen. *Ztschr. f. Gynaek. Urol.*, 1913, 18, 170.
- RUDALX, P. Pyélonéphrite gravidique, diagnostic et traitement. *Clinique*, Par., 1914, ix, 75.
- SADYCE, Pyélonéphrite pendant la grossesse ayant déterminé la mort malgré l'interruption provoquée de la gestation. *Compt. rend. Soc. d'obst. de gynéc. et de pœdiat. de Par.*, 1910, xii, 122.
- SCHUCKLE, G. Beitrag zur Kenntnis der Pyelitis und Nierenbeckenerweiterungen während und ausserhalb der Schwangerschaft. *Arch. f. Gynaek.*, 1912, p. 221.
- SCHLAYER, Schwangerschaft und Nierenleiden. *Monatsschr. f. Geburtsh. u. Gynaek.*, 1913, xxxviii, 27.
- SCHMIDT, MARTIN BENNO. Die Pyelonephritis in anatomischer und bakteriologischer Beziehung, und die ursächliche Bedeutung des Bacterium coli commune fuer die Erkrankungen des Harnwege. 1893.
- SCHWAB, M. A. Apropos de deux faits de pyélonéphrite gravidique. *Bull. Soc. d'obst. de Par.*, 1905, viii, 12.
- SIEBER, H. Experimentelle Beiträge zur Aetiologie der Pyelitis gravidarum. *Ztschr. f. Gynaek. u. Urol.*, 1911, iii, 295.
- SIPPEL, A. Pyonephrosis, pyelitis, and compression of the ureter during pregnancy. *Zentralbl. f. Gynaek.*, 1905, xix, 1121.
- SMITH, CARROLL. Pyelitis of pregnancy and puerperium with report of a case of toxæmia of pregnancy and pyelitis of puerperium. *Am. J. Dermat. & Genito-Urin. Dis.*, 1910, xiv, 532.
- STOECKEL, Pyelitis gravidarum. *Muenchen med. Wchnschr.*, 1913, ix, 2147.
- TASSIUS, ALBERT. Pyelitis in graviditate (Erlangen). *Frankfurt a. M.*, 1912.
- TEFFIER, T. La vaccinothérapie contre la pyélonéphrite aiguë de la grossesse. *Bull. et mêm. Soc. de chir. de Par.*, 1910, xxxvi, 783.
- TULEY, H. E. Pyelitis in pregnancy and the puerperium. *Ky. M. J.*, 1910, viii, 1806.
- VENUS, E. Die Pyelitis in der Schwangerschaft. *Wien. klin. Rundschau*, 1911, xxv, 517.
- VENUS, E. Pyelitis gravidarum, Sammelreferat. *Zentralbl. f. d. Grenzgeb. d. Med. u. Chir.*, 1911, xiv, 369; 401, 449, 500.
- VIANNAY, Pyélonéphrite de la grossesse guérie après 3. *Loire med.*, 1910, xxix, 154.
- VINEBERG, HIRAN. N. Pyelitis in pregnancy and the puerperium. *Am. J. Obst.*, N. Y., 1908, lvi, 769.
- VIOLET, Pyélonéphrite de la grossesse ayant persisté après l'accouchement, cathétérisme de l'uretère, constatation d'une rétention urétrale et pyélique lavages du bassin. *Lyonn. méd.*, 1914, cxxiii, 1271.
- VOORHEES, J. D. Pyelitis occurring late during the puerperium. *Am. J. Obst. N. Y.*, 1910, lxi, 501.
- WALLICH, V. Rapport sur une observation de pyélonéphrite pendant la grossesse. *Compt. rend. Soc. d'obst. de gynéc. et de pœdiat. de Par.*, 1910, xii, 117.
- WARD, E. The medical aspects of pyelitis in pregnancy. *Quarterly J. Med.*, 1903, ii, 69.
- WEIBEL, W. Pregnancy pyelitis, serologic and clinical. *Arch. f. Gynaek.*, vol. c.
- WEINER, W. Serologisches und klinisches ueber Schwangerschaftspyelitis. *Arch. f. Gynaek.*, 1913, xcix, 245.
- WIEDLER, F. Beitrag zur Pyelonephritis gravidarum. *Gynaek. Rundschau*, 1908, ii, 772.
- WEYMERSCH, A. Pyélonéphrite gravidique guérie par autovaccin. *Scapell. Liège*, 1913, lxvi, 775.
- WIDAL, F., and BÉNAUD, R. Pyélonéphrite gravidique descendante par septicémie coli bacillaire. *J. d'urolog. méd. et chir.*, 1912, i, 317.
- WILDBOLT, H. Ueber Dehnungs-pyelitis. *Cor.-Bl. f. Schweiz. Aerzte*, 1912, xia, 17.
- WILLIAMSON, H., and BARRIS, J. A case of pyelonephritis of pregnancy, with specimen of the urinary organs. *J. Obst. & Gynec. Brit. Emp.*, 1911, xx, 244.
- WOLFS, R. E. Pyelitis complicating pregnancy. *J. Mo. St. M. Ass.*, 1914, x, 416.
- ZIMMERMANN, R. Beitrag zur Aetiologie der Pyelitis gravidarum an Hand von Bakteriologischen Harnuntersuchungen. *Ztschr. f. Gynaek. Urol.*, 1914, v, 56.
- ZOEPRITZ, B. Schwangerschaft und Nephrektomie. *Ztschr. f. urol. Chir.*, 1914, iii, 48.

DEPARTMENT OF TECHNIQUE

PRIMARY CARCINOMA OF THE URETHRA, RETENTION OF URINE FROM OBSTRUCTION, RESTORATION OF FUNCTION BY RADIUM

By GEORGE ERETY SHOEMAKER, M.D., F.A.C.S., PHILADELPHIA
Gynecologist, Presbyterian Hospital, Consulting Surgeon, Woman's Hospital

THE occurrence of primary carcinoma of the urethra is so rare that all cases should be reported, and especially the influence which radium may exert on their relief is of interest.

L. S. McMurtry, after a search of the scanty literature, calls the urethra the "rarest location" for primary carcinoma. Many cases reported are merely extensions from other commoner localities and will not bear analysis.

Bringing previous searches down to date, he was able in his paper before the American Surgical Association,¹ to find but 26 cases, beginning with one reported by Madame Bonvan in 1828.

F. von Winkel,² says that such carcinomatous neoplasms are of extremely rare occurrence, and those reported have usually spread from the external genitalia or the vagina. He saw two primary cases and says that in both a pavement epithelioma had undoubtedly started in the urethral mucosa. The second patient had urethral and vesical calculi and died of uræmia. He refers to four cases published by Melchior and one by Robert in 1869. Their observations were that periurethral cancer appeared as nodules in the vestibule and extended thence in the cellular tissue along the urethra, without, however, affecting the walls or the mucous membrane of the canal, the nodules being at first hard, painless, and non-ulcerating. In the earlier stage, they do not extend to the depth of more than half the length of the urethra, in the second stage, they reach the pelvic fascia and the neck of the bladder.

Sielman³ mentions one case of carcinoma of the urethra as being considerably reduced in size, with relief of the accompanying dysuria, by application of X-rays. An interesting example of what radium may accomplish is reported by Legueu and Chéron⁴ of Paris.

A woman age 26, pavement epithelioma, at first involving the urethra, which was destroyed producing incontinence, extension to vagina. Radium applications by Chéron with disappearance of growth. Two and a half years later, death under operation for implantation of ureters in bowel. Autopsy, no microscopical malignancy.

The writer would record his only experience as follows, all others seen being instances of involvement by extension.

Mrs. W., multipara, a full blood Virginia negress, aged 50 years, applied at the Presbyterian Hospital because of overdistention of the urinary bladder with complete retention. Beginning about five months before (July 1915) there had been some difficulty in urination gradually succeeded by dribbling. For more than a week bladder distention had been extreme, and on admission culminated in inability to pass any urine at all. There had been no bleeding or pain, except that due to the bladder condition.

No ordinary sized catheter could be introduced, owing to a nodular infiltration in and around the urethral canal. The urethra felt through the vagina like a hard fixed ridge of the size of a lead pencil, extending from the meatus back nearly to the base of the bladder. The orifice was retracted, its edges hard, irregular, nodular, and ridge like. The vaginal surfaces were normal in color, the surfaces of the urethral mucous membrane were reddish but not ulcerating. There was no involvement of the cervix or uterus, the vagina and vestibule showing only senile changes, except close to the urethral canal. There was no tumor. A No. 6 urethral catheter was passed with some difficulty. It was used in and the bladder thus gradually drained. In the first 24 hours, 173 ounces or nearly 11 pints of urine were thus obtained and some was lost.

Bladder drainage and rest in bed caused sufficient subsidence of swelling to enable a No. 12 soft catheter to be passed after some days, but retention persisted.

Surgery was inadvisable as the removal of the entire urethra up to the neck of the bladder would have been necessary, with resulting incontinence. Radium was therefore advised. Dr. William S. Newcomet carried out this portion of the treatment, while the bladder paralysis and cystitis resulting from overdistention were being treated in the writer's service at the Presbyterian Hospital.

The patient was transported to and fro, from time to time, to the Department for Radiotherapy of the Jefferson Hospital where an applicator of proper size and efficiency was to be found. Between December 14, 1915 and January 4, 1916, nine applications in all were made, of three

¹ Tr. Am. Surg. Ass., 1908 p. 592.

² Cyclopedic of Obstetrics and Gynecology, 2, 53.

³ Fortsch. a. d. Geb. d. Roentgenstrahlen, Hamb., 1904, 220, 277.

⁴ Rev. prat. d. mal. d. org. genito-urin., 1914, 31, 86.

hours each. The quantity used was 20 milligrams of radium element.

The first few drops of urine were spontaneously passed December 24. The quantity gradually increased until by January 15 the bladder was completely emptied by the patient in a normal manner. There was no leakage, no pain and no bleeding. A No. 19 flexible catheter could now be passed.

The urethra still retained its pencil like feel. There was a short split in the lower portion of the meatus, doubtless due to traumatism of the rigid tissue. The radium produced a pallor of the mucous membrane both about the urethra and in the vaginal entrance, a form of radium burn, but there had been no loss of substance or ulceration.

The photograph was taken after the radium was used. A small piece was afterward removed at the edge of the meatus and examined in the laboratory of the Presbyterian Hospital by Dr. Damon B. Pfeiffer, pathologist. Microscopical report: Squamous celled carcinoma.

The Wassermann test for syphilis was negative and there was no specific history.

The inguinal lymphatics were not enlarged but when



Fig. 1. Primary carcinoma of urethra.

their removal was advocated, the patient disappeared, considering herself well.

INFOLDING AND PERITONEALIZING STITCH WITH APPLICATION OF THE SAME TO BROAD LIGAMENT AND GALL-BLADDER

By HARRY A. SHAW, M.D., SEATTLE, WASHINGTON

IN reference to the article by Dr. Williams of Lebanon, Indiana, entitled "A Zigzag Purse-String Suture for Gall-Bladder Work," printed in the January, 1916, issue of *SURGERY, Gynecology and Obstetrics*, and realizing fully the credit due Dr. Williams, by right of prior publication, I desire to point out certain fundamental errors in the said technique and to submit a technique evolved by myself and proved both clinically and upon the cadaver.

The technique submitted is simply an adaptation of what I call an *infolding and peritonealizing stitch*, one which has been successfully used upon broad ligament, mesosalpinx and meso-appendix, for more than five years, originally by myself, but in the last few years by a number of local surgeons.

The technique as published by Dr. Williams is impractical for the following reasons:

1. Zigzagging every stitch so frequently angulates the suture that it is almost impossible to draw the same through the tissue and it absolutely prevents symmetrically tight puckering around the drain.

2. The bite in the upper series of sutures is proportionately too short to produce a complete or smooth inversion, as inverting traction is produced by this line of sutures.

3. The added number of sutures coming out

on the lower line serve no useful purpose, are time-consuming, and complicating, although they look logical in pictures.

4. There has been no provision made for anchoring the tube.

TECHNIQUE OF CHOLECYSTOSTOMY

The technique which I use in cholecystostomy is illustrated by Diagram 1, a description of which follows:

It is important to make a straight clean cut in the fundus of the gall bladder (Diagram 1, Fig. 1). The suture preferably No. 1 hard tanned gut, mounted on Dulox needle enters at X (Diagram 1) passing through all the coats about three eighths of an inch from the cut edge. It is then passed from within out about one-eighth of an inch from the cut edge at the point marked O.

It is next passed from without in at the point marked I about one quarter of an inch from the original point of emergence i.e. O. The suture is carried in and out about one-eighth of an inch from the cut margin making the bite about one-quarter of an inch on the serous side and one eighth of an inch on the mucous side, until it passes in at the point of emergence i.e. O here it dips down and emerges at X² leaving a loop of gut about five inches long. This same procedure is then exactly duplicated on the other side, using the same needle and suture.

Figure 2 illustrates how traction in opposite directions upon A by the operator and upon B by the assistant produces an inversion of the cut edge. Occasionally there is not a perfect inversion of the central part of the cut edge, this being immediately corrected when the drain is inserted by a slight downward pressure upon the drain,

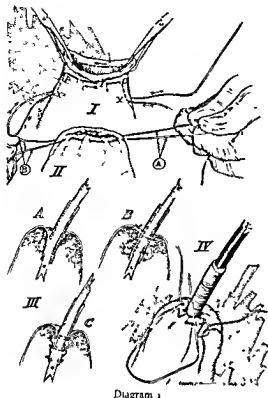


Diagram 1

just before the sutures are pulled snug for the stay knot, as illustrated in Fig IV.

Figure III A is a sectional view of above method illustrating the small amount of gall bladder consumed. B shows the method advocated by J. B. Murphy in a recent issue of *Murphy's Clinics*. Note the amount of gall bladder consumed by this method as well as the dead space, either real or potential, between the two suture lines. C illustrates the method in common use, i.e. two lines of sutures and drain tacked by two tacking sutures to the cut edge for the purpose of inversion. This is both tissue- and time-consuming.

After the tube is inserted (Fig IV), the ends (A and B Fig II) are tied (surgeon's knot) A by the surgeon B by the assistant. These are drawn snug simultaneously from each side so as to insure even puckering around the tube. The drain is then tacked in place utilizing the long suture ends for this purpose.

The advantages of the above technique are

1 The conservation of tissue. In cholecystostomy we are endeavoring to preserve the gall-bladder and restore its function (compare Fig III, A, B, C). By this method we certainly do not greatly diminish the capacity of the gall bladder.

2 There is no dead space (Fig III, B).

3 It produces perfect inversion in a simple, rapid, and efficient manner.

4 It renders easy the accurate insertion of the drain to just the correct depth. The tack suture in the drain serves the double purpose of fixing it *in situ* and assisting in preventing eversion of the cut edge.

5 By cutting loop (Fig II, B) and pulling and tying from both directions, it produces smoother and easier traction and a more symmetrical and tighter purse-string around drain.

Some operators may hesitate to trust one single strand of gut. I personally believe that such fears are groundless and believe that any gut that will stand sufficient strain to properly and tightly purse-string the viscus around the drain, will certainly remain *in situ* 48 hours, after which time union of the infolded serosa would render any accident to the suture harmless. However, if the operator so desires, a seromuscular purse-string can be quickly passed through the infolded walls, around the margin close to the tube, thereby insuring inversion and a snug fit (with practically no waste of tissue), should the original suture break.

I wish to condemn a practice, not at all unusual, i.e., the suturing of the drain to the abdominal wall. This is bad for the following reasons:

1 It does not allow for the natural mobility of the liver which assumes a somewhat different position, according to posture.

2 The liver, to a certain extent, participates in the respiratory excursion. Therefore, it is unwise to fix the drain to the moving parts, i.e., abdominal wall and liver.

3 The abdominal stitch is applied after the wound is closed and is almost sure to draw the gall bladder upward or force it down into an untoward position.

APPLICATION OF INFOLDING AND PERITONEALIZING STITCH TO THE BROAD LIGAMENT

As previously stated, the stitch used on the gall-bladder in cholecystostomy was suggested by the "infolding and peritonealizing stitch" which I devised and used for a number of years, upon the broad ligament, mesosalpinx, meso-appendix, etc. This would perhaps be an opportune time to show the application of the stitch in the technique of salpingo-oophorectomy, which I have used with satisfactory results in several hundred cases over a period of five years. The use of the stitch in this particular operation will give a practical idea of its utility and its application during the course of other

NOTE.—It may occur to the reader that chronic putrid No. 1 may not permit the removal of the tube at the earliest interval desired. A slight rotation of same back and forth will easily free it after five or six days.

surgical procedures This will be apparent to all that glance at the following illustrations and the accompanying legends (Diagram 2).

TECHNIC OF SALPINGO OOPHORECTOMY

To (a) bloodlessly remove our mass, (b) close the gaping defect in the broad ligament, and (c) peritonealize our denuded areas, are the special indications in salpingo-oophorectomy, all of which is accomplished with rapidity in the following manner. After proper exposure and exploration, packing-off field, freeing mass, etc., we proceed, as shown in the following anatomico-schematic illustration (These illustrations are purely schematic, thus illustrating the mechanics of the technique more efficiently than similar ones correct in anatomical detail)

Diagram 2, Fig I shows the clamp applied along the broad ligament, directly beneath the mass. The sutures first passing through the broad ligament at I and back at O, about one eighth of an inch from clamp, are then brought through again at F and back out at O', in again at P, etc., as per illustration. Usually three complete suture units are just right, however, occasionally two will suffice. A Ligature around the edge of the infundibulopelvic ligament, thereby securing individual ligation of ovarian artery. B individual ligation of the ascending branch of the uterine artery. C suture passed through the cornu, just above and back, just below the tubo-uterine junction. This to be tied immediately upon excision of the tube (see Fig II)

Figure II shows the mass including the proximal tube, excised and C ready for tying

Figure III shows the mass removed. In removing the mass we use scalpel and direct blade toward the clamp to avoid the danger of cutting the suture

Figure IV illustrates how traction in the opposite direction upon each suture end draws the two separated layers of



Diagram 2

the broad ligament together and infolds the ragged edge

Figure V shows the infolded edges being pleated into position and held there by tying suture, thereby closing the gaping defect in the broad ligament and restoring the normal anatomic support to the uterus

A NEW OPERATION FOR THE TREATMENT OF VARICOCELE

By Dr. DELFOR DÍ L VALLE, BUENOS AIRES, ARGENTINE

Chief of the University Clinic, Surgeon, Ramos Mejia Hospital

SINCE the primitive operation of Curling up to the time of Stromm of Krakau, there have appeared a series of operations for the treatment of varicocele which have been based on the cremaster, the veins, the scrotum, and finally on the tunica vaginalis or aponeurotic plastics. These operations have been described by Celso, Pablo de Eguir, Cooper, Petit, Bonomo, Osborn, Cartu, Vince, Mori, Mease, Narath, Ricord, Vidal de Casis, Richard Barwell, Pegaud, M. Jeune, Bonet, de Vallet, Nelaton, Richet, Gould Beonard, Breschet, Delionil, Y. Y. Petit, Freund, Nandonzi, Samson, Guyon, Berningtree, Gunnar, Moriguet, Jacobsen, Parona, Posadas, Goniour and Totonium.

Goniour of Bucharest, while recommending his procedure, rightly says that the operations based on resection of the scrotum are innocuous and those which alter the veins are noxious. I hold a similar opinion as to these operations because clinical experience proves that resection of the scrotum is generally followed by recurrence and that extirpation of the anterior venous group produces dystrophias of the testicle and chronic congestions. These symptoms are chiefly due to the suppression of the spermatic artery which is the most important artery entering the gland. The experiments of Charles I. Smolet on dogs and rabbits prove these facts by showing that the epithelium cells of the gland degenerate and the glycogenic and fat disappear.

This plainly shows that complete extirpation is dangerous. The technique perfected in Dr. Decoud's clinic overcomes these difficulties by preserving the spermatic artery and the veins of the cord. Therefore besides being preservative, the operation diminishes the congestion of the veins by alternate ligatures and suspends the testicle at a convenient height, thus correcting the ptosis. I have personally treated over 60 cases by this process and have followed 20 of them closely, two three and four years after the operation. In only one case a complete cure was not obtained, due undoubtedly to a technical error during the operation. The results so far are very satisfactory as good, if not better than those attained through any of the other methods. (Edema and pain in the cord and testicle so frequently noted after these operations were not observed.)

The photographs accompanying this article, taken before and after the operation show the favorable modifications of the scrotum and the new position of the testicle in some of the most typical cases.

STEPS OF THE OPERATION

First step Palpate the external abdominal ring and make an incision over it, from five to six centimeters long, passing through the skin, the superficial and intercolumnar fasciae. Separate the edges of the incision with Farabeuf's retractors, thus displaying the external abdominal ring, with the cord passing out between the internal and external pillars (Fig. 1).

Second step Carefully incise the infundibuliform fascie so as to expose the parts of the cord and vas deferens, the veins, artery, etc., which are retracted outward, then dissect the veins, from the external abdominal ring to the testicle, from the other parts of the cord. Usually five or six veins can be found greatly increased in size, with varicose dilatations, and anastomosing one with the other by similarly affected collaterals (Fig. 2).

Third step The group of veins is now lifted forward from the wound by the assistant who holds each extremity between the finger and thumb of each hand, maintaining this position throughout the next step of the operation, the object being to avoid any rotation of the veins. The operator carefully separates the veins into two groups, an anterior and a posterior (Fig. 3).

Fourth step A catgut ligature is now passed and tied around the posterior group, one finger's breadth above the upper limit of the testicle. Another ligature (silk) is similarly applied to the anterior group but two fingers' breadth above the level of the catgut suture and left long. It is advisable to follow the above details carefully as upon their exact performance, especially the measurements, as the amount of circulation left to the testicle depends entirely on the level at which the upper ligature (silk) is placed. In this way, the cord can be shortened by some four to five centimeters (Fig. 4).

Fifth step One finger's breadth internal and parallel to the fibers of the internal pillar of the ring make an incision four centimeters long through the fasciae. Pass a Kocher's forceps

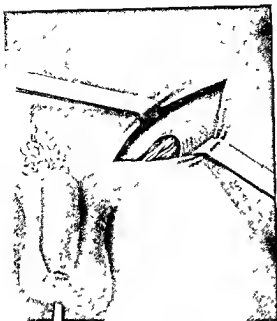


Fig. 1 First step of operation

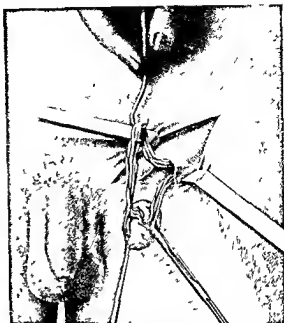


Fig. 2 Second step of operation

through this incision and the subjacent conjoint tendon, making it come out through the ring. Pick up the ends of the silk ligature in the forceps and pull them through, thus making the anterior group of veins pass through the opening in the fascia and raising the testicle (Fig. 5).

Sixth step Having carefully fixed the level

at which it is desired to leave the testicle, the end of the silk ligature with a needle is passed through the fascia of the external oblique and tied. The operation is finished by suturing the edges of the incision in the fascia together behind the loop of the veins, thus leaving each end of the incision open for the veins to pass through (Fig. 6).



Fig. 3 Third step of operation

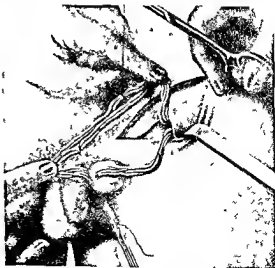


Fig. 4 Fourth step of operation

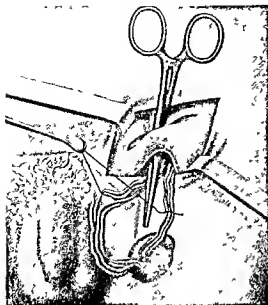


Fig 5 Fifth step of operation

It should be stated that if the posterior group of veins is the one affected, the steps of the operation are the same, except that in the fifth step the opening is made in the external pillar of the ring, instead of in the internal

BASIS OF THE NEW PROCEDURE

As I have already shown the different procedures which have so far been used for the surgical treatment of varicocele, all rest on a pathogenic and symptomatic basis. The procedure now proposed rests on a similar basis, but while it observes closely all the factors which justify the operative treatment of varicocele it is superior to them all in being the most conservative.

The principles of the operation may be divided into three groups: (1) anatomical, (2) physiological, and (3) pathological.

Anatomical The veins of the cord form two groups with relation to the vas deferens. Some anatomists recognize three, but the so-called third group, viz the lateral, in practice belongs to the anterior group. This group (the anterior) is made up of five or six veins, which anastomose freely with each other, two or three centimeters below the ring, so that while they reach the testicle, they form a true plexus.

The spermatic artery, the principal artery of the testicle, is found in this group. The posterior group is formed in the same way and con-

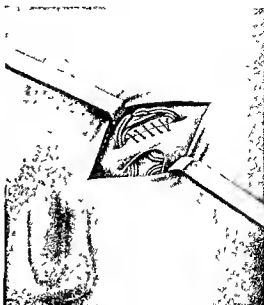


Fig 6 Sixth step of operation

tains the deferential and funicular arteries, both smaller than the spermatic and not so important in the nutrition of the testicle. Now when the principal trunks are interrupted alternately and at different levels by an anastomosis, the blood current is forced through the anastomosed collaterals and largely suppressed in the principal trunks themselves (Fig 7).

Let *A, B, C*, and *D* represent the four principal veins coming from the testicle with their anastomosis branches, *a, b, c, d, e, f, g, h, i, j, l, m, n, o*. A ligature is applied to *C* and *D* at *S*, and another to *A* and *B* at *S'*. The blood flows in *C* and *D*, being obstructed at *S*, passed by the collaterals *o* and *n*, arrives at *A* and *B* by an angular route. Similarly the blood in *A* and *B* is obstructed at *S'*, and has to pass by *d* and *e* and so finds its way to *C* and *D*.

This scheme rests upon the following fundamental principle: The blood in any of the large venous systems (vena cava) obeys the same hydraulic laws as does the liquid circulating in any system of tubes which communicate with each other. Applying this principle to the spermatic veins we get *1* in Fig 7, four or five parallel tubes of a known diameter coming from the testicle and united among themselves by the collaterals which form angles with them. In this system each second a more or less constant quantity of blood passes which we shall call two units

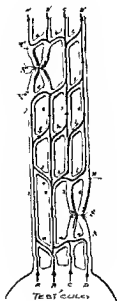


Fig 7 Diagram showing venous distribution in the testicle

When the veins become varicose, the quantity of blood which passes per second is increased to four or five times the normal, or from two to eight or ten units



Fig 8 Diagram showing I testicle, II vas deferens, III spermatic artery, IV ligature of veins, anterior subgroups, V ligature of veins, posterior subgroup, VI veins of anterior group, IX veins of posterior group

This can be observed clinically, by comparing the veins of the affected side with those of the sound one, when it can be both seen and felt that



Fig 9 Man 22 years old before operation



Fig 10 Same as Fig 9



Fig 11 Same as Fig 9 after operation

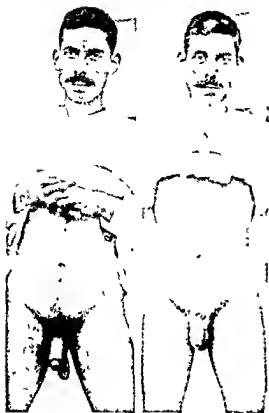


Fig. 12. Man of 28, before operation (at left) after operation (at right)

the affected veins are four or five times more bulky than the healthy ones.

If in this system we place two obstacles *S* and *S'* we get conditions similar to those enumerated in the hydraulic law. If in a system of parallel collecting tubes which are united among themselves by tortuous tubes of smaller caliber, obstacles are so placed that the liquid has to pass by the connecting tubes the current will be reduced and the discharge in a given time will be less than when the obstacles did not exist. Applying this principle to the anterior group of veins—steps 3 and 4 of the operation—we obtain (1) a notable diminution of the stream and consequently to a certain extent a decrease in the amount of stasis, thereby alleviating the symptoms of atrophy and dropping of the testicle and neuralgia of the cord, all of which are aggravated by the upward posture. (2) As the spermatic circulation is only interrupted alternately and at different levels in its two branches the total

flow is not diminished owing to the anastomosis (Fig. 8).

PATHOLOGICAL ANATOMY

The very complete study of the pathological anatomy made by Cornil shows that the varicose dilatations affect the large trunks chiefly and the collaterals secondarily and both acquire proportions much greater than the normal caliber.

In an un.injected corpse, the dissection of the veins, especially of the collaterals, is a matter of extreme difficulty. In the living subject, it is easier and easiest of all when a varicocele exists, due to the greater size of the collateral branches, which are of the size of the normal trunk veins, these in turn being as big as the cephalic or basilic vein. This increase in size of the anatomical parts renders the ligation of the veins as described in the third and fourth steps of the operation, a matter of relative simplicity.

Histologically a chronic mesophlebitis is the chief noticeable change. This produces a great thickening of the venous walls and they are rendered rigid so that the group of veins forms an excellent and solid cord by which to maintain the testicle well braced up (sixth step). Though based on the same principle as the operation of Longuet a further advantage of this procedure is that the fate of the testicle is not compromised by an excess of veins as in his (Longuet) operation.

As Poirier has pointed out, the varicocele is cone shaped, the base of the cone below corresponding to the testicle and the apex at the external ring. This is due to the fact that in the canal the veins are supported by the walls of the inguinal canal and so only become varicose lower down where support is absent or lacking. Narath's operation is based on this observation, he proposed to ligate the veins in the inguinal canal, but as Poirier shows, this is simply to suppress the functions of the veins *en masse*. In my operation the veins are placed in such a position that they receive the maximum support from the constant pressure of the surrounding tissues, and this tends to add tone to the walls and prevents any further dilatation, since they lie between the external oblique in front and the internal oblique and conjoint tendon behind.

Instead of complete ligation which Narath practiced and which entirely suppresses the veins, my operation, by reason of the aponeurotic bridge which the suture of the incision of the external oblique forms (sixth step), produces an obstruction to the circulation each time the muscle contracts, forming in this way a kind of living ligature, which is most active when the patient moves about on his feet in other words the effect is

produced exactly at the moment when most needed

SUMMARY

The proposed technique is undeniably superior to any other method applied up to the present day, for the following reasons

- 1 The technique is simple
- 2 The operation diminishes but does not suppress the function of the affected venous group
- 3 The circulation of the spermatic artery is not suppressed
- 4 The testicle is suspended by the same group of veins that are extirpated in the other procedures
- 5 The greater part of the veins placed between the muscles of the abdomen suffer a constant elastic pressure which tends to diminish their aneurismal tendency
- 6 The testicle is furnished with a living suspender
- 7 Although it diminishes the venous congestion and raises the testicle just as do the other radical methods, it is essentially conservative

BIBLIOGRAPHY

- TESTUT and JACOB *Traité d'anatomie topographique*
 TILLIAC *Anatomie topographique*
 TESTUT *Anatomie descriptive*
 SAPPEN, C *Anatomie descriptive*

- MONOD and VANVERTS *Traité de technique opératoire*
 FORDYCE *Patologia externa*
 KEEN *System of Surgery*
 LE DENTU and DELBET
 HÉLOT *Arch gen de med*, 1844
 MONTANÉ *Du traitement curatif du varicocele Thèses de doct*, Strasbourg, 1868
 DELAGENESTE *Varicocele et traitement Thèses de doct*, Paris 1869
 DELBET *Gaz d hôp* 1870
 RICHARD BARNELL *Lancet*, Lond., 1869, p 711, 1875, p 870
 BRYNING *Lancet*, Lond., 1881
 HORTÉLOUP *Ann d mal d org genito-urin*, 1884
 LE DENTU *La cure radicale du varicocele Ann mal d org gen urin*, 1887, p 99
 GENIN *Cure radicale du varicocele Thèses de doct*, Paris, 1876
 CURRY, T B *Traité des maladies du testicule*
 LEMONET, CHARLES *Contribution à l'étude du testicule quelques infections Thèses de doct*, Paris 1903
 IFFERER, FERNANDO *Varicocele Tesis del Doctorado*, 1905
 GARCIA ALBERTO *Varicocele Tesis del Doctorado*, 1913
 LAURENT *Anatomie clinique et médecine opératoire*
 MONOD and TERBILLO *Affections du testicule*
 IREXAS *Tratamiento del varicocele Independ méd* 1885
 GAYON *Hémos clunques sur les maladies des voies urinaires* 1881
 GOMOU, V *Rev de chir*, 1913 No 1
 LOSTON, J *Zentralbl f Chir*, 1914, J d'urol, 1912, 1913, 1914, J de chir, 1908 to 1914
 GUNNAR, N *Nord med Ark*, 1912, xlv, 116

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD JANUARY 21, 1916, WITH THE PRESIDENT, DR. CHANNING W. HARRIS, IN THE CHAIR

A GIANT PYOSALPINX

DR. MERRILL WEISS (by invitation) exhibited a specimen of large pyosalpinx and in connection with the same made the following remarks:

Chronic pyosalpinx is not at all uncommon. It is a condition met almost daily in hospital practice in gynecology. In the extensive literature on the subject there is frequent mention of the formation of large tumor masses as the affected tubes increase in size during and after the stage of active pus formation. Usually in the descriptions of these tumors comparisons are made as to size and weight but as a rule accurate dimensions are seldom noted. Thus it is difficult indeed to give credit where it is due for reports of the largest or most unusual tumors formed in chronic pyosalpingitis.

In reporting the case in which this specimen was removed no attempt is made to put it on record for its size alone. However, we have considered it sufficiently interesting from both clinical and pathological viewpoints to warrant this brief mention.

CASE 45,066. The patient Mrs. L. A. B., a white woman, aged 47 years, was admitted to the Presbyterian Hospital June 6, 1915, in the service of Dr. J. Clarence Webster. The following history and physical findings were obtained:

Complaint. (1) Tumor mass in the right lower portion of the abdomen. (2) Pain in the left lumbar region. (3) Headache. (4) Loss in appetite and weight.

History of complaint. (1) During health with general indisposition was noted some months ago. Upon examination the patient's physician found a mass in the abdomen and since that time the patient has been able to note its presence. She thinks that it has increased in size during the past few weeks. (2) Pain in the left lumbar region has been noted at intervals for the past three years. It is of a sharp stinging type but does not radiate in any particular direction. It is not particularly aggravated by the patient's domestic life. (3) Headache over the frontal and parietal regions has been noted for some months, no definite time of onset was noted. It is not associated with nausea or vomiting. (4) The appetite began to fail about four or five weeks ago. Her usual weight is 130 pounds, present weight 122. There is little or no distress from food.

Menstrual. Flow began at 11 years. Regular

24 day type. Flow lasts 2 to 3 days, no pain at periods. Last period began June 1, 1915.

Marital. Married twenty years, pregnant once with induced abortion at third month three years ago.

Medical. Measles, mumps, and scarlet fever in childhood. Patient is occasionally jaundiced. No other distress. Surgical. Negative except for the above noted in last abortion.

Family. Parents dead, brother and sister alive and well. No chronic family disease. **Habits.** Appetite poor, bowels constipated, urination normal, uses tea, coffee, and alcohol in moderation.

Physical examination. A fairly well nourished young woman whose color is yellow. Sclera show subicteric tint. Head and neck otherwise negative.

Chest. Lungs and heart negative. **Abdomen.** There is a small prominence in the lower abdomen, most marked on the right side. No tenderness or rigidity in the abdominal wall. On palpation a three-lobed firm tumor mass is outlined. There are no vessel sounds over it and no pulsation noted. Liver and spleen are not palpable. Extremities are negative. Reflexes normal.

Genital or menation. Intuitus admits three fingers, cervix smooth and high in the vaginal vault, uterus with appendages apparently twisted slightly to the right, palpable tumor mass in the right fornix moves with motion of tumor with left hand on abdominal wall.

Blood. Leucocytes 13,000, hemoglobin 20 per cent. Bare blood pressure systolic 118, diastolic 80.

Urine. Negative except for a few epithelial cells and polymorphonuclear leucocytes.

Temperature. On admission 98° F., pulse 80.

At operation June 10, 1915, laparotomy was made in the median line. Abdominal findings were as follows: Left tube is huge, about 10 by 15 cm., twisted twice on its ligament attachment and lies in the right side of the abdomen and pelvis. Two loops of ileum are adherent to it. The right tube is indurated, right ovary cystically degenerated. Several gall stones are present in the gall bladder, two small ones in the cystic duct. The right kidney is normal, left kidney small and thin. A nodular hard mass about the size of a man's fist is palpable in the mesocolon at the sigmoid flexure, with indurated glands round about. (Initially excised.) The appendix is thick and bound in adhesions.



Fig 1 A giant pyosalpinx, 30 cm long, 8 cm average diameter, weight 1,540 gms

Operative procedure consisted in removal of the left tube and ovary, the right tube and the appendix and sign-drainage of the right ovary.

The patient made an uneventful recovery from operation and left the hospital on the seventeenth day. Her relatives were told, however, of the presence of probable malignant growth at the sigmoid flexure of the colon and the prognosis was shaped accordingly. About one month later report of the patient's condition was obtained through the kindness of her family physician, Dr MacMartin. At that time there were physical signs of a small collection of fluid in the abdominal cavity and a marked general weakness. The patient died after apparent symptoms of malignant disease late in September, 1915.

The pathological report on the specimen removed at operation is as follows: The tumor is sausage shaped, 30 cm long, 11 cm greatest diameter, 8 cm average diameter, 6 cm minimum diameter. It weighs 1,540 gms. Its surface is smooth and glistening except for two abrasions and an area of attachment 4 cm long at which point the tumor was severed. There are numerous tortuous, purplish blood vessels immediately beneath the surface and plainly visible. There are several small roughened areas, sites of previous adhesions separated in the removal of the tumor. On palpation the tumor is elastic, with slightly less firm areas at several points in its extent. Adjacent to the point of attachment lies an ovary embedded in parametrial tissue. It is 5 by 3 by 2 cm in dimensions and is cystic at the proximal pole and on its posterior surface, and markedly sclerotic on its anterior surface. There is a band of adhesions 15 cm long extending from the posterior lower aspect of the ovary to a point 8 cm from the lower pole of the tumor.

No free pus was obtained on aspiration of the firm tumor mass. It was hardened *en masse*. Later microscopic sections were made from several blocks of tissue. These showed chronic inflammatory changes in the tubal tissue with some fibrosis of the muscular coat. Special search for evidences of malignancy and tuberculosis revealed nothing.

In closing it may be of interest to mention one fact in connection with the clinical diagnosis of the case which was recalled at the time of operation by Dr MacMartin. In 1905, ten years ago, the patient was seen by Dr Webster because of complaint of slight pelvic pain. She was told at that time



Fig 2 Pus tube weighing 19 1/4 pounds

by him that one tube was twisted and swollen and was advised to have it removed. She disregarded this advice and had no marked discomfort until the present history begins, but the diagnosis was amply confirmed at operation.

I am indebted to Dr Webster for the opportunity to present this case.

UNUSUALLY LARGE PYOSALPINX

DR DANIEL HALE WILLIAMS and MR KENNETH HALLOCK (by invitation) exhibited a specimen of huge pyosalpinx.

The patient from whom this rare and unusually large specimen was removed is Mrs H., aged 36. She menstruated at 16, and continued to menstruate regularly until she was about 27 years of age. From that time up to about three years before she was operated upon the menstrual period would last from six to seven days, with considerable increase in the quantity of the flow. So far as I can ascertain she has never been pregnant, and she has no recollection of ever having had a vaginal, uterine, or pelvic infection. This reference is important because it may have some bearing on the question of primary infection which is discussed in the pathological report of the case by Mr Hallock.

Of the four blood examinations that were made, none of the laboratory reports show any marked reaction. The leucocyte count varied little from 7,000 during the time of the patient's stay in the hospital. This is not an uncommon feature in old pus cases.

The urine furnished an index of what followed. She came to the hospital with an albumin showing of 20, specific gravity, 1,008, there were no casts. Amount voided in 24 hours varied from 13 ccm to 16 ccm. Notwithstanding the condition of her urine, it was not accepted as a contra indication against operation, for the patient stood the operation well and made a perfect recovery.

Further investigation led me to the conclusion that important amyloid changes were taking place, which were undoubtedly due to the long continued absorption of septic products from the extensive pus tube.

I first saw and examined this woman more than six years ago, at which time I found that the solid tumor had grown well downward into the cervix and latterly extended to the limitations of the small pelvis, but it was not impacted. The patient suffered much pain at times in both lower extremities due to the pressure of the tumor on nerve trunks. The soft associated mass could be palpated above the puls. Operation at this time was advised, but was refused. Three years later I examined the patient again and found that this solid tumor was well out of the pelvis and was extending into both flanks. The soft part of the growth had extended quite as high as the umbilicus. Three years later when she came for operation the growth had attained a sufficient size to fill the entire abdomen causing great embarrassment to respiration. The solid fibrous tumor was clearly defined and satisfactorily understood by combined palpation. The fluctuating accessory mass was not well defined or understood, and it was thought by those practitioners who examined her that as the fluctuating mass was very closely associated with the well known fibroid it was a fibrocystic growth.

At the operation a long median incision was made to determine the boundaries and ramifications of the growths. A hand syringe aspiration was made and a specimen withdrawn and sent to the bacteriological laboratory for examination. After examining the specimen Dr. Moody reported that it was pus. On the strength of this information it was decided that the case was one of suppurating cyst.

The entire growth was removed and sent to Dr. LeCount's laboratory for examination and diagnosis. Three days later I was informed by Dr. LeCount that what we had supposed was a suppurating cyst was really a pus tube and he asked "that perhaps none so large had ever been noted."

A diligent and thorough search of the medical libraries of Chicago and that of the Surgeon General's Office at Washington discloses no report of a pus tube of quite one half the size of the one here with recorded.

I am deeply indebted to Dr. F. R. LeCount for his recognition and diagnosis of this very rare specimen also to Dr. H. M. Moody, resident pathologist in St. Luke's Hospital for the histological work, and to Mr. Kenneth Hallow for the preparation of the specimen and for the following pathological report.

The specimen weighed at the time of operation 19¼ pounds it was 17 5/8 inches in length and 22 7/8 inches in circumference at its largest diameter. It was filled with a yellow viscous material of the consistency of thick cream. On histological examination this was negative for both teratomata and anembryonic organisms.

The external surface is smooth and shining and well supplied with blood vessels deeply injected which radiate outward from the central point of the concave side. At this point the two peritoneal folds composing the broad ligament are seen and

between them the ovary, of approximately normal size, completely surrounded by its capsule and containing a large blood clot and a corpus albicans.

It was not considered advisable to destroy the value of the specimen by cutting into it in order to make microscopic sections but we have no doubt that the specimen is a fallopian tube since (1) It was attached to the right cornu of the uterus lying lateral and posterior to the uterus corresponding in position to the left tube. (2) We note the complete ovary surrounded by its capsule lying in the folds of the broad ligament. (3) In shape it is elongated and curved differing in this respect from ovarian and tubo-ovarian cysts which tend to have a spherical outline.

A search through the available French, German and English literature failed to reveal any report of a tube approaching this size in size.

It was suggested to the writer that the negative bacteriological findings and the lack of inflammatory changes would suggest rather a cystic condition of the tube. We were able to tell in a brief search through the literature, three limited and two cases of uniducted pyosalpinx which were negative for the common pyogenic organisms as follows:

Menge	23 cases
Morax	12 cases
Shrout	145 cases
Wertheim	72 cases
Kelly	31 cases

DISCUSSION

Dr. HENRY. What does the histological examination of the opposite tube show?

Mr. HARTMAN. There was quite a little histological examination but it did not reveal anything because the probabilities were there would be no tubal epithelium left after this time and Dr. LeCount did not want to destroy the value of the specimen by cutting into it for microscopic work.

PYELITIS OF PREGNANCY WITH ESPECIAL REFERENCE TO ITS ETIOLOGY

Dr. W. C. DANFORTH presented an inaugural thesis entitled "Pyelitis of Pregnancy With Special Reference to Its Etiology" (see p. 743).

DISCUSSION

Dr. CHARLES B. REED. I think this paper of Dr. Danforth's is a very timely one. It is a subject which has been interesting to obstetricians particularly for a number of years and has only recently been studied as it should have been. Dr. Danforth has covered all the points very systematically and thoroughly. There is one part of his paper, however, that I think needs a little more emphasis, and that is in regard to the treatment. The treatment is still under discussion. In my own experience I have seen a number of these cases which were operated upon by surgeons of repute and the women aborted,

and it has seemed to me that in nearly every case where the kidney has been interfered with, abortion has resulted. In consequence of this experience I feel that if the case has progressed to such an extent that interference with the kidney is demanded, abortion should be produced first. The woman should first have the uterus emptied, and if the condition does not clear up, a subsequent kidney operation can be done. As a matter of fact, most of these cases clear up under treatment spontaneously in about two weeks. I believe they are self limited, but there are cases that do require emptying of the uterus primarily and the kidney operation secondarily, rather than the reverse.

DR THLODOR J. DOEDERLIN. Of the few cases I have had of this type of disease, there is one in particular which I reported in the *Journal of the American Medical Association* several years ago. As I remember the case, it was strictly a self limited disease, lasting about three months. I had the patient in the hospital for three months prior to delivery. The patient was very ill with chills fever and sweats the temperature going up to 104 or 105° F. There were pure cultures of colon bacilli in the urine, but directly after delivery the urine was normal. I examined the woman two or three months afterward and found the urine normal. This led me to believe that the source of trouble was not an ascending infection but rather a blood infection which localized itself—an short, a *locus minoris resistentie*. This case was very interesting to me because the woman was so sick before delivery and so well after treatment. I think operative interference as recommended is unnecessary, as Dr Reed has suggested. It is a distinctly self limited disease.

DR A. SPROAT HEANEY. The point I wish to discuss is whether or not pyelitis of pregnancy can be really called self limited. When the uterus is emptied at full term or prematurely, the patient is as a rule promptly rid of her fever, localized pain and all the other symptoms of her pyelitis. Her urine however does not clear up entirely and does not tend to clear up without further treatment. In the event that she becomes pregnant again while the urine is still abnormal she will again have pyelitis—though usually not so severe as in the first attack since this disease is more acute in primiparae.

I have now under observation two patients illustrating this fact. One of these patients has had six previous pregnancies in four of which the diagnosis of pyelitis was made. During one pregnancy a surgeon wished to remove the kidney, but since preliminary abortion produced a symptomatic cure the nephrectomy was not done. She was aborted one other time because of pyelitis. In the other two attacks she carried the children to term. She is again pregnant and though she has no symptoms of pyelitis she has pus and colon bacilli in her urine and is in consequence quite liable to have a pyelitis during this pregnancy. This patient has undoubtedly never been entirely free of pus or bacilli during

any of her pregnancies and will be subject to recurrences until during an interval we can rid her urine of the colon bacilli.

Another patient now under my attention has had pyelitis in both of her previous pregnancies. In the first she was said to have had an appendicitis in pregnancy and a recurrence in the puerperium, in the second pregnancy the pyelitis was diagnosed. Though only three months pregnant now, her kidney is beginning to cause some pain and the urine shows pus and colon bacilli. Neither of these patients has received thorough treatment after delivery. I have had several patients where the urine was freed of pus and bacilli after their pyelitis, that have gone through second pregnancies without any pyelitis.

Of especial interest in Dr Danforth's paper is his notice of the confusion between pyelitis and appendicitis in pregnancy. It has never been my experience to see a real case of acute appendicitis in pregnancy—though they, of course, occur—not as often, however, as diagnosed. The symptoms are much alike and I have been called several times where this mistake was made, twice by physicians for their own families. No one should call such an attack an appendix without examining microscopically a catheterized specimen. I have known of several inoffensive appendices being removed under these circumstances where the fever persisted and the diagnoses made only subsequent to operation. Every case should be treated after delivery and a conscientious effort made to rid the urine, not only of pus but of organisms.

DR RUDOLPH W. HOLMES. Unfortunately, I was not present while Dr Danforth was reading his paper, but I would like to present a case report which is appropriate to this discussion of pyelitis. It is really inconceivable that my report can be true, but I can depend on the veracity of those who attended, and watched the patient through her illness.

A woman on New Year's eve had company. During the evening she had a great deal of dysuria, with diarrhoea, which continued for three or four days thereafter. At the end of this time she was constipated for a few days, evacuations being secured by cathartics. From the ninth day to her death her stools were watery. I saw her on the ninth day of her illness at which time she was conscious and she positively maintained she had not urinated since the last day of the old year. Her attending physician had repeatedly catheterized her, and when he did not do so, a nurse did. At no time was there more urine than would fill the glass catheter and the fluid was purulent. She died on January 16, and during these 16 days she secreted no urine other than that mentioned. She had a large tumor of the upper right quadrant which completely filled it, encroaching about two inches beyond the mid line, and the same distance below the umbilicus which was determined to be a pyelitic kidney. She was about seven and a half months pregnant. Her complexion was of a yellowish waxy type. The first consideration was to termin-

rite the pregnancy and accordingly, under a light ether narcosis the os was manually dilated (it already admitting two fingers), the head was crowded deeply into the pelvis and low forceps were applied. From the beginning of the operation to the completion of delivery only eleven minutes elapsed. I was in hopes of doing a cystoscopic and ureteral catheterization in a day or two after but such was not permitted me. She was opened in the left flank by others in the hopes that a decapsulation of the left kidney might relieve a possible left compression and reflex stasis but no kidney was found. However on the twelfth day on going in on the right side, a tumor was found which was so large and looked so forbidding the surgeon did nothing.

I cannot reconcile myself to the fact that a woman could go sixteen days without any urinary secretion and above all things that she could remain conscious during the same period. It might have been that there was an uretero intestinal fistula which caused the later watery stools, but this is a mere conjecture.

Of course pyelitis is a matter of degree. Formerly only the fulminating cases were recognized. Now we know that many a so-called cystitis is actually a pyelitis with bladder symptoms as the preponderating signs of disease the purulent urine from the kidney keeping the bladder infected and irritable.

In mild cases of pyelitis conservative procedures should be the rule in aggravated types irrespective of the duration of pregnancy. I believe the emptying of the uterus has a beneficial effect on the disease and often should be elected.

Some months ago I saw a woman two or three months advanced in pregnancy who had had a fulminating attack of pyelitis in a previous pregnancy. I was the fourth or fifth physician to see her. Two were genito urinary surgeons and one at least wanted to remove the kidney although there was not a sign of trouble then present, the other desired that the uterus should be emptied. The only suspicious sign was the fact that contributing a twenty four hour specimen a few colon bacilli were thrown down. Under the advice of expectancy she passed through the pregnancy without any disturbance whatsoever. Certainly catheterization and washing of the kidney should be tried before a nephrectomy for pyelitis.

DR RICHARD S. YARROS. I had a case that was extremely interesting to me a few weeks ago of a woman whom I watched carefully during the fifth month of pregnancy. I had examined her urine twenty four hours previously and sent a specimen to the laboratory, which was carefully examined and the report was negative. On Sunday she went to the country and was exposed to cold although she did not feel cold and when she came home Sunday morning she noticed a little blood on the sheet. She said to me "Do you believe I am going to miscarry?" I told her to sit quiet. "She did not tell me about the cold in the evening. She did not telephone for me. The next morning more blood came away but I found it was not blood from the uterus

but blood that came from the urine, which she had not noticed before. I had a catheterized specimen of urine, and found it was full of blood corpuscles. Twenty-four hours later she called me up in the middle of the night and said she had a severe hemorrhage. We took her to the hospital, catheterized the bladder again, and we found the consistency of the urine was that of blood instead of urine and the next day we had one of the genito urinary specialists make a cystoscopic examination. He said he had never found such an injected disease of the bladder. He catheterized the ureter on one side and also got turbid urine in which was found the colon bacillus on cultivation as well as a number of red blood corpuscles. Nitrate of silver was injected the patient was put to bed and a dubious prognosis was made. She improved in the next twenty four hours. The urine improved very much and after three days was absolutely normal. We have had no other cystoscopic examination made and there has been no evidence of blood for the last month, and apparently the woman has made a perfect recovery. Of course blood in the urine is not uncommon in pregnancy at least blood corpuscles but such hemorrhage from the bladder I have never seen before. Twenty four hours before that the urine was normal and the specialist did not want to say it was due to exposure to cold. He could not explain satisfactorily the extreme condition. He thought of tuberculosis and of other things, but it could not have cleared up in so short a time if there was anything serious. The woman has made a splendid recovery and I cannot explain the condition on any other ground than that it was due to the exposure to cold. We did not make a bacteriological examination of the previous specimen before the blood appeared.

I should like to know how many cases any of the members have seen of this kind and what their explanation is as to the condition of this woman since we can find nothing abnormal now.

DR W. C. DANTRETT (closing). I was hoping someone would go into the bacteriological side of this subject. So far as the treatment of the malady is concerned I agree fully with what has been said by Dr Reed and Dr Holmes. I do not think a radical operation on the kidney is the thing to do unless one is forced to do it by the absolute presence of pyelonephrosis. If the case is seen by a competent man I do not see any reason for a radical operation. Palliative means the use of the ureteral catheter, and if necessary emptying the uterus are the things to do.

I have no explanation to give of the case which Dr Yarros reports unless a bacteriological examination of the urine would afford an explanation.

CONTRIBUTION TO THE STUDY OF TWILIGHT SLEEP

By CHARLES B. REED, a paper entitled "Contribution to the Study of Twilight Sleep. A Study of One Hundred Cases" (see p. 636).

DISCUSSION

Dr. JOSEPH L. BAER. I have only a few words to say on this subject. In brief, I would refer the members to an article that appeared in the *Journal of the American Medical Association* six or eight months ago, representing a period of two months of observation of scopolamine morphine analgesia carried out at the Michael Reese Hospital. That series was under the observation of my seniors, Drs. Cary and Frankenthal, and myself. The cases were watched, as such cases should be watched, and the results we obtained were so radically unfavorable as to compel us to abruptly terminate the series.

Most of the things mentioned by the essayist occurred in our series, such as soiling the genitalia, delirium, death, maternal and foetal and yet we feel that everyone of the precautions had been taken to avoid such accidents. Our material consisted largely of Russian, Polish, and Jewish women and as the essayist has pointed out, they are supposedly emotional, and hence supposedly unsuitable for this particular form of treatment. However, Dr. John Osborn Polak, of Brooklyn, when he was here last year and told us how to do this, laid special emphasis on the point that this treatment was well chosen for nervous, high strung, emotional women. Likewise, among the few remaining enthusiasts for "twilight sleep" in this country, Dr. Rongy of New York has exercised his series of cases entirely on Jewish women in the Beth Israel and Jewish Maternity Hospitals and he is, as I say, really an enthusiast. We felt that the risks were real, that the jeopardy of the women was real and we were unable to select suitable cases by any method we could determine as efficient. If we knew which cases were going to react favorably to the scopolamine morphine analgesia we would be delighted to resume the series, because in our series of seventy odd cases, there were about six thoroughly successful analgesias but we do not know how to pick out those in which the treatment will be suitable and rather than repeat our disastrous experiences we are withholding final judgment which, as Dr. Reed has pointed out, must come after all reports from all sources have come in.

One point should be made and that is, throughout all continental Europe in all the larger clinical centers for some years past, long before it reached this country in its present furor, twilight sleep was given a thorough trial. Beginning in 1904, clinic after clinic from the Baltic to the Mediterranean has dropped it, until now there is left only the center of Freiburg and one or two smaller centers to keep the flame flickering. The most recent and really honest judgment came from Fried in Switzerland who sums it all up in these words that he cannot see the advantage sufficient to justify the jeopardy in which it places both mother and child.

Dr. BERTHA VAN HOESSEN. I am glad of the opportunity of hearing Dr. Reed's paper for I am afraid I have become accustomed to the sentiments of the present speaker much more than the senti-

ments Dr. Reed has expressed. It is very encouraging to hear someone who has tried the Freiburg method, and who is not discouraged with what is known as painless childbirth. I know almost nothing of the Freiburg method, because we use at the Mary Thompson Hospital almost exclusively a fixed dosage, which is a much heavier or larger dosage than the Freiburg method. I think it is probably due to that that we have in all cases had what Dr. Reed did not seem to be able to get with the Freiburg method, absolutely painless childbirth, and we begin as soon as there is even a suggestion of labor. In practically no case, if we have time, do we wait until the pains are strong enough to annoy the patient.

The dosage that we use is one eighth grain of morphine and one one hundredth grain of scopolamine as an initial dose. In one hour one one hundredth grain of scopolamine is given, and at the end of another hour another one one hundredth grain is given. The patient is then under the anæsthetic, and after that time the room is dark or quiet, it makes very little difference to the patient. We keep the room dark and keep all persons from the room in which the patient is going under the anæsthetic but after that time it matters very little if the curtains are up and people are talking even loudly or are in the room. They do not disturb the patient, and the patient does not recall what is going on. This dosage was determined and built up on the time that it takes to eliminate scopolamine morphine from the system, and it has proved to be most satisfactory not only in the Mary Thompson Hospital, but also in the practice of many doctors outside who have taken up this method.

I had our superintendent give me a report this afternoon of the last 600 cases that we have had in the hospital. Of this number, 525 were "twilight," and 75 were "non twilight." These 75 that were "non twilight" were made up of patients who were brought into the hospital by doctors who are not on the staff who do not give "twilight," or a few patients who came in late and did not wish to have "twilight." In the 525 cases with "twilight" there was one maternal death, which occurred after the second convulsion. The patient was a nephritic, death occurred after the second convulsion, three hours after labor. Of the 75 "non twilights," there was one maternal death due to an internal hemorrhage four hours after delivery. In the 525 "twilights" there were 12 stillbirths, in the 75 "non twilights" there were 13 stillbirths. Of the infants that died during the first or second week following birth in the 525 "twilights" there were 14. Of those who died during the first or second week that were "non twilight," there were 2.

It may be of interest to know the cause of death of the stillbirths. There were 12 in the "twilight." Of the 12 stillborn, there were 2 macerated, 1 hydrocephalus, 5 premature, 3 syphilitic, and 1 not yet determined because microscopic work and post-mortem have not been done. Of those who died

during the first and second week, 2 were hydrocephalic, 1 had a complete umbilical hernia, all abdominal contents lying outside the body, 2 atresia of the oesophagus, 1 a congenital heart lesion, 6 were premature, 1 had cerebral hemorrhage, and 1 was hemophilic.

The percentage of deaths among infants in the "twilights" in the 523 cases is less than Dr. Keef's for counting those which were born dead. We have 2½ per cent, counting those that died afterward we would have 3 per cent. Dr. Keef, I believe, had 8 per cent. While comparing "non twilights" we had 20 per cent stillbirths and 3 per cent died later.

To me, these figures emphatically demonstrate that the child has a much better chance to live during delivery under "twilight" than without it when we had 20 per cent. If those 75 had "twilight," we would not have had 13 stillbirths. We probably would not have had any more than 2½ per cent stillbirths as we did under "twilight."

The doctor mentions the islands of pain. In this first dosage we entirely eliminate the islands of pain, and instead of having 85 per cent, we will have on an average 99 or 100 per cent of successful "twilights."

I feel I must say a word or two about the series of cases they had at the Michael Reese. I feel that every series of 100 will probably present entirely different results. We have here Dr. McCann, interne at the Mary Thompson Hospital, and she informs me that of a series of 50 cases there was not one unsuccessful. Dr. Conn during her internship, had a series of 100 that were successful. She had a most unusual series—so unusual that I can remember her 100 cases very well. She had not had one forceps delivery in a hundred. She had not one hemorrhage, she had not one stillbirth and she had only seven tears. Four of the women were multiparae and three of these tears were in primipara. That was one continuous hundred. Dr. McCann's was another continuous hundred. She had one forceps delivery, one laceration that she had to repair, so I feel every hundred will represent some new and perhaps some special thing will be demonstrated. When you come to a series of 500 you have a great many different things illustrated but one thing certainly must be brought out and that is where you have but 1 maternal death in a series of 500, where there had been placenta previa and twins and many cases of eclampsia (there were at least a dozen cases of eclampsia) contracted pelvis and hydrocephalus, the results must be considered remarkable. We had very many complications and when we had a series of 500 with one maternal death, and that due to eclampsia, I should have been much surprised if that patient had lived. When you have only 5 per cent mortality among the children and that includes all of the peculiarly deformed children that were practically unfit to live. I feel that Dr. Baer ought to be willing at least, to try two or three more hundred and see if he cannot get something as

uniquely successful as his cases have been uniquely unsuccessful.

Dr. CHARLES B. REED (closing). I have very little to say in closing the discussion. So far as my observation goes, the trouble is not with the Jewesses as such, but I think highly emotional as they are they lack possibly the inhibition which other peoples equally emotional may possibly possess. I do not know that is so. I know that in our experience our violent disturbances all came with the Jewesses, and I feel with Dr. Baer that if his series was anything like the four I had I would not want any set of internes or nurses to carry out the treatment.

As to dropping the treatment abroad I think the war is ample excuse for that. The hospitals over there are being used very largely for the wounded from the front and there is very little or no attention paid to the women.

I am very glad to learn from the Mary Thompson Hospital their results have been so favorable and I trust they will continue so.

POST-OPERATIVE ILEUS

Dr. WILLIAM M. THOMPSON read a paper on titled "Post-Operation Ileus" (see p. 689).

DISCUSSION

Dr. CHANNING W. BARNETT. I have very little to add in regard to this paper. I read a paper upon this subject some years ago and I have had more experience with these cases than I wish to have. I will say this that I had more experience with post-operative ileus during the time I was using scopolamine morphine anesthesia than before or after its use. Patients seem to have a more stormy time with their intestinal tracts after the use of that than at other times. I have had a number of patients recover when they were in a desperate condition, in which we did an enterostomy, draining and later closing the fistula. I think we may look forward to the time when in many instances, we can do an enterostomy to relieve the obstruction at the time do nothing else and have the patient recover the use of the bowels after the inflammatory period has stopped the fistula closing entirely of its own accord. I have had a number of cases of that kind.

THYMUS DEATH

Dr. FREDERICK FALLS (by invitation) read a paper entitled "Thymus Death" (see p. 712).

DISCUSSION

Dr. CHARLES B. REED. I would like to ask Dr. Falls how he makes percussion in these cases when the child is in the prone position?

Dr. FALLS. The method of percussing the gland in the prone position is advised by Jacoby, but I have never seen Jacoby perform it. I should imagine it would be done best by having the child supported possibly by a second individual and simply percussing the gland in that way.

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD FEBRUARY 4, 1916, WITH THE PRESIDENT, DR. SAMUEL C. PLUMMER, IN THE CHAIR

INTERMITTENT HYDROPS

DR. VICTOR L. SCHRAGER This man is 25 years of age, and ever since he was 14 he has had periodic swellings of the knee. At the beginning, the knee would swell every two or three weeks, then he had periodic swellings four or five times a year. In June, 1913, he had a painful swelling which recurred twice in rapid succession. When I saw him I injected formalin and glycerin empirically, and ever since then a curious thing has happened, he has had recurring swellings every ten or twelve days. The symptom-complex is very definite. He knows a few hours before that his knee is going to swell. At first there is a sense of fullness and then within eight or ten hours the knee swells and remains swollen about forty-eight hours, during which time he has no pain but has a slight limp. The last time the knee was so swollen that he could not take his trousers off. I have aspirated this knee three times and found perfectly clear fluid, with no chemical or cellular constituents. There is noluetie, Neisserian, or any other type of infection. There is no focal infection of the teeth or the gums. There is no etiology. This case belongs to the class described as angioneurotic edema.

SURGICAL REPAIR OF A STAB WOUND OF THE PERICARDIUM

DR. WILLIAM FULLER The first case I desire to present is the one before you now. This man is an Irishman, 28 years old, strong and of athletic build. On the night of November 14, 1915, he had an encounter with another man and from him received three stab wounds with an ordinary pocket knife, the blade of which measures two and a half inches in length.

One wound was just over the left kidney and the other over the outer side of the arm. Neither amounted to much, as both were superficial and required for their closure only a few skin stitches. The third wound, which was at the junction of the left sixth rib with the sternum was a most serious one, the knife severed the rib at this point, opened the pleural cavity, collapsed the lung, and cut the pericardial sac open for the distance of about two inches.

This man walked some distance after the stabbings but fell finally, exhausted from the loss of blood. He was taken to a hospital and admitted to the service of Dr. C. F. P. Korssell. He was seen by us in a short time thereafter and his condition was as follows. The pulse was barely perceptible. The respirations were irregular and shallow. His skin was cold and clammy and presented a very pronounced pallor. When the patient was moved

about or turned to one side, great streams of blood would spurt from the chest wound, and the inrush of air with respiratory acts, owing to a collapsed lung, was very noisy.

The patient's general condition was so extremely grave that further time was not lost in getting him to the operating table. He was hurriedly given a few whiffs of ether, and the chest was painted with iodine. Through a skin incision running out from the stab-wound to a point on the sixth rib some six inches away, the rib was resected and removed. Division of the intercostal muscles and parietal pleura disclosed the extent of the injury. The lung was only partially collapsed, the chest cavity contained many large clots and much free blood. The heart could be seen and felt beating feebly and irregularly, and showed the pericardial incision as mentioned, and also the pericardial sac distended with blood clots. The pericardial cut occupied approximately a position on the left anterolateral surface of the heart and extended to within one inch of the apex.

Retraction of the fifth and the seventh ribs, the sixth being cut, gave a good view of the damage done and also easy access of the heart. Two long forceps, one on either edge of the pericardial incision, held the heart in the chest opening and with a continuous catgut suture the pericardium, after emptying the sac of blood clots, was tightly closed. This suture besides closing the rent in the pericardium completely checked all bleeding from the margins of the pericardial incision.

With the hand introduced through the opening in the chest-wall all clots were removed and the chest-cavity was carefully sponged out with large packs wrung out of normal saline solution. The opening in the thorax was now tightly closed by first approximating as closely as possible the parietal pleura, then the intercostal soft parts, and finally the skin. No drainage at any point was used.

During the operation which lasted about thirty minutes, the patient received normal saline solution subcutaneously and about as much as could be put under the skin over the pectoral regions. He was returned to bed in fully as good condition as when he was placed on the operating table. His condition for three days following was not good. The pulse ranged from 120 to 150, the temperature reached 102° F., and his skin showed the same pallor. The lung by the third day was completely expanded, although no effort was made at the operation to remove the air from the chest-cavity. At the end of this time the pulse diminished in frequency, the temperature fell to normal, and the patient's general condition was much improved. The stitches were all removed on the tenth day from wounds which had

not suppurred, and the man left the hospital at the end of the third week entirely recovered.

No one surgeon has had sufficient experience in this kind of surgical work to justify important opinions or statements as to the proper surgical procedure in all instances. The only law seems that of expediency, and what would prove good surgery in one instance, might not be as valuable in another instance. The literature shows that a large percentage of the cases die from infection, and from the infection which no doubt followed the efforts at drainage.

If one's experience is limited to a single case observations of some value are not impossible. In our case the collapsed lung seemed to be of distinct value. First it gave easy access to the heart and facilitated our efforts at repairing the pericardial injury. Secondly, it probably lessened hemorrhage from the pericardial wound, at least this is a point emphasized by Matas, who has had more than the average experience with this kind of work.

It is questionable whether efforts should be made to expand the lung even at the close of the operation. The use of any differential apparatus is time-consuming, and again not always at hand. Aspiration of the chest-cavity might be accomplished at the concluding steps of the pleural closure, but it should not be forgotten that a collapsed lung will, without this, expand in a very short time.

Pleural and pericardial drainage at the time of surgical repair of stab-wounds, which of necessity are generally clean, seems contrary to accepted surgical principles today. If indications for drainage are in doubt during the repair of such wounds it would appear much safer to close the wounds without drainage, owing to the great danger in this step, and institute it later if the need of it arises.

BONE TRANSPLANT OF THE HAND, METACARPAL BONE

This young woman is 25 years of age. She is not of the vigorous type, but her personal history furnishes nothing that in any way relates to the condition about to be described.

Upon the prominence of the metacarpophalangeal joint of the little finger of the right hand, she had a small wart, which she attempted to destroy with caustics, now about one year ago. She succeeded in destroying the wart in the manner described, but produced at the same time an infection of the wound which soon invaded the joint mentioned, as well as the lower end of the metacarpal bone. During a period of several weeks following the infection the patient received the most appropriate treatment by her physician Dr. John I. Haskell. In addition to this treatment two or three efforts were made surgically to limit the infection and save the bone, curettement and drainage of the joint, with removal from time to time of necrosed pieces of bone availed little. The process continued until the entire metacarpal bone was necrosed and re-

moved. Following this the wound healed promptly, but left a badly deformed hand, the hand was made much narrower than before, and the little finger assumed a position almost at a right angle to the other metacarpals, giving a most unsightly appearance.

To correct the deformity of the hand a transplant was suggested as a possible means of accomplishing this step. The patient returned to the hospital a few weeks later and the transplant was made in the following manner. The hand was opened through the old scar left after removal of the metacarpal. No Esmarch was used and all capillary bleeding or oozing into the wound or around the transplant after closing the wound was thus prevented. Before removing the tibial graft, the wound in the hand was packed tightly with sterile gauze wrung out of hot salt solution and wrapped with a sterile bandage. The graft was now removed from the tibial spine including periosteum and endosteum. The hand was now unwrapped and unpacked showing a wound absolutely free from bleeding. Into this wound in the hand the graft was placed and there anchored by two or three catgut sutures. The skin was closed with silk worm gut, the hand dressed, placed on a splint and suspended. At the end of ten days the stitches were removed from a perfectly healed wound and the patient left the hospital.

At the end of about five weeks' time the new piece of bone had become solidly united to the proximal phalanx. It felt and otherwise appeared to be of the same length, size and shape, as when transplanted. If any changes whatever had then occurred, or have since occurred, the skiagrams which have been made every month since that time fail to disclose them.

In all seven skiagrams have been made representing the condition as it appeared from month to month. From the first one which I now show you the graft resembles in every detail the same piece of bone which came from the tibial spine. The second, the third, and on to the last skiagram show the same thing, no changes of any kind have taken place. This autogenous graft therefore has not proved osteogenic or osteoconductive; but remains there the same living piece of tibial spine that was placed in this young woman's hand now seven months ago.

There now remains only one step to complete the original aim to restore the symmetry and usefulness of this hand and that is an arthroplasty at the metacarpophalangeal joint. Before attempting this final step it was deemed wise to allow for the elapse of sufficient time for whatever changes might ultimately take place in the transplant.

There is some difference of opinion as to what takes place in transplanted bone. That it is often absorbed yet proves an important factor in the subsequent production of bone is probably true. Again it seems just as probable that under certain conditions a graft may live and remain as the final bone without any changes whatever. When an autogenous graft is placed in a locality where bone

is needed, and every provision made for immediate nourishment as was attempted in the case here reported, it seems reasonable to expect continued viability of the graft.

REFLEX ILEUS OF RENAL ORIGIN

DR DANIEL N. EISENDRATH read a paper entitled "Reflex Ileus of Renal Origin" (see p 698).

DISCUSSION

DR ROY G PIERCE (by invitation) I really did not expect to be called upon to discuss this paper, but the problem which Dr Eisendrath has presented this evening is interesting from the standpoint of the physiologist, for the reason that it brings up the discussion of the mechanism of excitation and inhibition of smooth muscles. There is very little absolutely known concerning these processes. The chemical and physical control of these processes, which are so important in the body, are such that it is rather hard to formulate definite theories as to how they are brought about.

The splanchnic stimulation by the reflex pain can hardly explain the long continued dilatation of the gut as described by Dr Eisendrath, and in searching for an explanation for this long continued dilatation of the gut I have thought of some experiments which Cassel and Orell have conducted with reference to bivalve mollusks. If the bivalve mollusk closes its shell and keeps it closed, even though more than four pounds of pressure per square centimeter is exerted on the little mollusk to pull apart the shell, it will be found exceedingly difficult to open the shell. The mollusk will keep its shell closed from twenty-four to thirty-hours. If you catch a mollusk as it is closing its shell with a piece of wood it will grasp the piece of wood tightly, and if you wedge the piece of wood out of the shell the latter will remain just half open, just as when you take an object out of a vice. If you push it together it will close, but you can easily open it to that point and it will not close until you stimulate the nerve of the adductor muscle.

I do not know whether it is interesting to you or not, but there are muscles which control this action in the case of the bivalve mollusk. There is a strong adductor muscle which produces this closing of the shell and there is besides, a smaller muscle which keeps it closed when once it is closed, and if you cut the nerve of the strong adductor muscle when the valves are closed, it makes no difference, the small muscle has caught the shell in that position and keeps it in that position. However, if you also cut the nerve of the small muscle the valve can be easily opened. If you stimulate the nerve going to the central ganglion the small muscle will contract and hold the shell together.

In this example it seems to have a mechanism by which we can explain something of the tonus of visceral muscles. It is a theory because we can conceive of viscera being held by the inhibitory excitatory nerves midway between excitation and

inhibition, that is, in a state of tone, just as we know muscles and viscera are held, because we can remove viscera from the body and do not get extreme dilatation of the gut, so we can conceive of this state of tone being due to some mechanism like that which holds the shell together without the expenditure of any energy. The bivalve mollusk does not extend its anything when it holds the shell together in that way. It holds it without the expenditure of any energy. The amount of oxygen which the mollusk takes up during the same given time is unchanged. So it means its muscle is cut and it is independent of any excitatory nerve mechanism.

It seems to me that due to the long continued dilatation of the gut, we may be able to explain in the same way the splanchnic excitation in reflex ileus. We have produced a state of fixation of the gut in the dilated position, the gut is held in that dilated position, and it is only by a sort of gut mechanism, as in the bivalve mollusk, that ileus is brought about. It takes a strong excitatory process to cause the gut to assume its tone.

DR DONALD MACRAE, Council Bluffs, Iowa: I have not seen any case of exactly the type Dr Eisendrath speaks of, but in so far as the kidney stone is concerned I have seen several cases. I have in mind two cases in boys which occurred quite recently following injuries. One was the result of a horse kick in the back and the other was due to a fall, the boy jumping from one stall to the other, falling and striking on his right side upon a board. Both of these cases occurred some distance from my town, and I was called several days later to operate for general peritonitis. That was the diagnosis given over the phone. The abdomen was immensely distended. There was no evidence of peristaltic action. In both cases apparently the ileus was marked. The kidney was not seriously thought of at that time. On careful examination it was evident there was bulging in both cases. They were both opened through a lumbar incision, and a large amount of urine, blood, and broken down kidney substance came away, shortly after which the ileus disappeared.

I have seen ileus result from a twisted pedicle in cases of gangrenous ovarian cyst. These cases were diagnosed as ileus or obstruction of some character without any inflammatory condition whatsoever, and shortly after the removal of the cyst the symptoms of obstruction disappeared. I cannot conceive of that being the result of an inflammatory or infectious process, but rather to be determined along the line spoken of by Dr Eisendrath.

DR ARTHUR DEAN BEVAN. For years one of the common recognized causes of ileus has been gallstone colic and kidney colic. I have seen a number of cases of ileus in kidney colic cases. Some of them have been rather interesting from the standpoint of mistakes in diagnosis, in that they have been handled as cases of acute indigestion, with very marked abdominal symptoms, vomiting, distention, which were relieved within twenty-four to thirty-six

or forty eight hours after opening the belly. These cases have been classified as typical abdominal cases involving the stomach and intestines, but later the cases were definitely cleared up by the demonstration and removal of a stone from the kidney.

I do not question the explanations that are offered by Dr. Eisendrath and Dr. Pierce, and yet we may be perfectly sure, when we think for a moment about the facts as they are presented in these cases, that the explanation, after all, is not a very simple one. If it was merely a reflex irritation, why should we not have constantly in every case of gall-stone colic, in every case of kidney colic, more or less evidence of this condition of paralytic ileus? We all know of dozens of cases of kidney colic without any abdominal symptoms at all, without any evidence whatever of paralysis. The explanation has not as yet been found.

I would like to emphasize the importance of this subject and to place on record one case in which the result of paralytic ileus was fatal. A man, who was operated on five years ago at the Presbyterian Hospital for kidney stones, died in about seven or eight days thereafter of paralytic ileus, emphasized and expressed especially as gastric ileus, as an acute dilatation of the stomach without any peritonitis, without any involvement of the peritoneal cavity. It was apparently one of those extreme cases of ileus without peritonitis following a kidney stone operation.

DR. E. C. RIEBEL. I would like to ask Dr. Eisendrath, if, in the post-mortem examination on the third case of hæmorrhage into the kidney, he examined the lining of the bowel, and if so, whether there

were any changes in the mucosa of the intestine due to the distention?

DR. DANIEL N. EISENDRATH (closing). In reply to Dr. Riebel, at the autopsy there was no examination made of the intestines, I only secured permission to examine the kidney.

DR. L. A. GREENSFELDER, my colleague at the Michael Reese Hospital, gave me permission to include in my paper a case which resembles very closely one of the cases Dr. MacRae spoke of. The patient was a boy, who was sent in with a diagnosis of ileus following a fall upon the loin. His abdomen was greatly distended, he was vomiting, he had all the classical symptoms of that condition, but when the abdomen was opened and the retroperitoneal tissues were found to contain a large amount of blood for the ileus symptoms it was immediately suspected there was some other cause. A rupture of the kidney was found and the kidney removed.

The whole clinical picture of that case was one of ileus, completely overshadowing the symptoms of injury of the kidney.

I feel as Dr. Bevan does that we cannot explain all these cases upon the reflex theory because we know there is a variation. But judging from the work of Cannon on adrenalin, we will have to accept this as a working hypothesis for the present.

DR. A. J. OCHSNER read a paper entitled "Surgery of the Colon," which was illustrated by slides.

DR. WILLIAM C. MACCARTY, Rochester, Minnesota, read a paper (by invitation) entitled "A Biological Conception of the Evolution of Carcinoma Based on a Study of Breast Cancer."

CORRESPONDENCE

ANTERIOR TRANSPERITONEAL HYSTEROTOMY

To the Editor: The article entitled "Anterior Transperitoneal Hysterotomy," by Dr. John B. Deaver, in the April issue of *SURGERY, GYNECOLOGY AND OBSTETRICS*, should not be passed over in silence. Its distinguished author advocates the use of transperitoneal hysterotomy, because he has "been doing it for years with no mortality and with the satisfaction of knowing that certain obscure conditions have been found and eliminated by early and radical means, which by the more conservative methods now in vogue, would have failed both of early diagnosis and proper treatment."

The author's thesis is based upon a series of 64 cases. The material may be divided into two classes, gynecological and obstetrical. Under the first grouping we would place:

1. Eight cases of symmetrical myomatous enlargements of the uterus. They represent simple myomectomies, in which the operator was not sure of his diagnosis until he had incised the tumor. In the ordinary and generally accepted sense, such cases are not classified as hysterotomy in the literature. Two cases of myoma and pregnancy are noted (three simple myoma of pregnant uterus are mentioned in the table), in which "the foetus was sacrificed" (no mention of the age of the foetus). From the data on hand, it is impossible to judge whether some operators would not have tried conservative myomectomy if they had opened the abdomen. No mention is made of the indications for which these operations were performed, although it is well recognized that fibroids rarely disturb the course of pregnancy or labor.

2. "Twenty-one cases were operated on because of bleeding which aroused suspicion of malignant disease of the interior of the uterus." Of the 21 cases upon whom a laparotomy was performed, 7, or less than 30 per cent had malignant conditions, warranting the risk of such extensive operation, 1 chorio epithelioma, 1 early corpus carcinoma. Ten cases showed "retained products of conception," 3 cases "benign polyp of the endometrium," and 6 cases "chronic hyperplastic endometrium." Although the author states that the majority of these cases had been curetted one or more times without relief prior to the operation, he does not mention whether the curettage was performed by himself or other competent surgeon, or whether the scrapings had been subjected to microscopical examination. I furthermore, he leaves us in doubt as

to whether the *transperitoneal curettages* which he performed benefited "the chronic hyperplastic endometritis" cases permanently.

Turning now to the obstetric conditions described (31 in number), he says "Three children lived, the remainder all being under six months and non-viable." This represents a foetal mortality of 90.3 per cent.

1. Placenta prævia, 10 cases average duration of pregnancy 4 to 7 months, maternal mortality nil, foetal 43 per cent. Just how many children out of 10 cases survived, so as to give 43 per cent foetal mortality, is not clear. In one case, at least transperitoneal hysterotomy was performed for *placenta prævia* (1) at the third month. Does this need further comment?

2. No details are given regarding the three cases of toxæmia of pregnancy and two cases of toxæmia of pregnancy and eclampsia, although the mortality statistics of various clinics are given *in extenso*. No mention is made of immediate induction of labor by the metturizer, although the dangers of "immediate manual and instrumental dilatation of the cervix" are emphasized in contradistinction to the harmlessness of hysterotomy.

3. "Ten cases of premature separation of the placenta, suspected of placenta prævia" are noted. The duration of the hemorrhage averaged seven weeks (1), the course of the pregnancies averaged only four months, only one of the ten being over five months. In seven of the ten cases the operator also performed appendectomy. Does this description in any way correspond to the dreaded premature separation of the placenta near or at term, known to the obstetrician, or should this group be included in the author's classification of "one of the abnormalities of childbirth, producing a large maternal and foetal mortality?" The writer sees no reason to classify these ten cases other than as *impending or inevitable abortions*, the fetus being dead, the placenta being either completely detached, or in process of separation.

4. The complete absence of data in the cases of "severe renal infection during pregnancy, amounting almost to sepsis" (the italics are ours) prevents any attempt at analysis, but why laparotomy should be preferred to induction of labor or abortion is not stated.

While we do not doubt the fact that "in experiments on guinea pigs carried on at the Lying-in

Hospital in New York, it was found that, after opening and carefully suturing the uterus, the scar was very difficult to find on microscopic examination" we would like to know how these experiments can be transferred without critique to the human being, so as to substantiate the preceding statement that "there is no danger in future pregnancies if you cut well, and sew well."

Dr Deaver is to be congratulated that his series of 64 hysterotomies show no maternal death or no serious post-operative accidents. Should less experienced surgeons follow his advice, and for instance perform laparotomy 21 times for bleeding from the uterus, suspicious of malignancy, their results might not bear as strict a scrutiny. To advocate hysterotomy in various types of threatened, impending or inevitable abortion (for most of the cases of prævia and premature detachment of the placenta in the early months are classifiable in these clinical groups) is shocking to the gynecologist and obstetrician, who in far greater series restores these patients to health by conservative measures, such as simple observation, packing of the cervix, insertion of a bag, or, in the early months, by curettage.

"Blind scraping of the inside through the cervix with a sharp curette is one of the most pernicious practices in medicine." Agreed to, and endorsed! But is blind opening of the abdomen, and then emptying or scraping to be more highly recommended to the profession?

New York

ROBERT T FRANK

The above letter was submitted to Dr Deaver, who replies as follows:

To the Editor. It is not surprising to me, having lived through the period of opposition to every seemingly radical though salutary measure introduced into abdominal surgery, to meet with criticism of my extension of the field of transperitoneal hysterotomy to deal with conditions not already recognized as warranting it. I note with approval, however, that the chorus is decidedly less vociferous than was the case when the operation for its now classical indications was first advocated.

As for the carping at cases which after operation did not show a lesion necessitating hysterotomy I can only say that in the article in question it is distinctly stated that "I acknowledge that at times

conditions are found which could be relieved from below."

The fact that in many thousands of operations upon the pelvic organs during the past few years but a small number of hysterotomies have been done for these conditions is an evidence of the care with which selection has been made. I presume that the willingness to criticize these recurrences arises from the fact that the obstetrician and gynecologist after his punctilio of "simple observations, puckering of the cervix, inversion of a bag or curettage" can look back upon an unbroken series of correct diagnoses, early radical intervention where necessary, none where it is not necessary, and uneventful recoveries. It is because after many years' experience with these and like measures that I have not met with like success that I have adopted what is apparently a more radical measure in selected cases regarded by me as too grave in their potentialities to admit of watchful waiting or of measures that may prove to be less than sufficient. In a dangerous road I prefer to travel by light rather than by darkness. And it is because of the satisfaction I have had in so doing that I feel gratified in bringing this operation not to the attention of every cross road surgeon who may perform it for insufficient indications, but to the attention of the experienced abdominal surgeon who will use it in emergencies and when in legitimate doubt of how to proceed.

My conception of the surgeon's duty is more and more that of one who is concerned chiefly with the prevention of mortality and the greatest amount of morbidity. The results of this operation in my experience have disposed of the former fears and I am not so much interested in criticisms that display nothing but a bias in favor of one method of accomplishing the same result in less important conditions as I am pleased with the opportunity of interrupting the course of malignant disease at the earliest possible moment or delivering a woman promptly and safely from the perils of infection, hemorrhage, or toxæmia.

JOHN B DEEVER

Philadelphia

NOTE: For the benefit of Dr Frank and his obstetric and gynecologic colleagues I may add that since writing my paper I have done 15 hysterotomies, making a total of 79 without mortality. The average stay in the hospital of these patients has been fourteen days.

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Clinical Congress of Surgeons of North America

SEVENTH ANNUAL SESSION
PHILADELPHIA
OCTOBER 23 TO 28, 1916



CLINICAL CONGRESS OF SURGEONS OF NORTH AMERICA

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PLANS FOR THE PHILADELPHIA MEETING

It is evident from the number of registrations already received at the office of the Secretary-General that the limit of membership fixed for the Philadelphia session will be reached within a short time. Bearing in mind that several hundred surgeons who wished to attend the Boston meeting last October were disappointed because their registrations were received too late, it is urged upon those surgeons who wish to attend the Philadelphia meeting, but who have not sent in their registrations, that application should be made immediately to the Secretary-General, Dr. Franklin H. Martin, 30 N. Michigan Ave., Chicago, Illinois. When the required number of registrations has been received no further applications can be accepted.

A careful survey of the operating amphitheatres, lecture rooms, and laboratories of the several medical schools and hospitals in Philadelphia, as to their capacity for accommodating visiting surgeons, has been made and the limit of attendance based upon this survey. The

popularity of these clinical meetings has become so great that the plan of limiting the attendance and requiring advance registration was decided upon to prevent overcrowding. This plan assures accommodations at the clinics for all who hold membership cards and has worked satisfactorily at the two previous meetings, in London in 1914 and in Boston in 1915.

THE CLINICAL PROGRAM

The schedule of clinics and demonstrations to be given by the clinicians of Philadelphia during the week of October 23d as published in these pages is a tentative one and is to be amplified and corrected from month to month as the work of the Committee on Arrangements progresses, so that the final program will properly represent the clinical work of the Philadelphia surgeons. The Committee on Arrangements has planned for a complete showing of Philadelphia's clinical facilities in every department of surgery, including gynecology, obstetrics, genito-urinary

surgery, orthopedics, surgery of the eye, ear, nose, and throat, together with many demonstrations on borderline subjects

EVENING MEETINGS

The Executive Committee of the Congress is preparing a program for a series of evening meetings. The Presidential meeting occurs on Monday evening, at which time the President-Elect, Dr. Fred B. Lund of Boston, will deliver the annual address. On each of the following evenings, excepting Saturday, there will be sessions of the section on general surgery in the Ball Room of the Bellevue-Stratford, and on two evenings of the week there will be separate meetings for the section of surgery of the eye, ear, nose, and throat. At these evening meetings papers will be read by visiting surgeons who have been selected because of their special fitness to discuss the subjects under consideration. Philadelphia surgeons will be selected to participate in the discussion of the papers. The complete program of the evening meetings will appear in these pages in a later issue.

MEMBERSHIP—REGISTRATION FEE

The Constitution of the Congress provides that all subscribers to the official journal, *SURGERY, GYNECOLOGY AND OBSTETRICS*, are members of the Congress and that such other legally qualified practitioners as are in good standing in their own communities may become members upon registering at an annual meeting and paying the registration fee.

The constitution also provides that a registration fee shall be required of each member attending an annual meeting, there being no annual dues for members of the Congress. The registration fees provide funds to meet the expense of preparing for and conducting the annual meetings so that no financial burden is

imposed upon members of the profession in the city entertaining the Congress.

HEADQUARTERS

Headquarters will be established at the Bellevue-Stratford where the Ball Room, Clover Room, Red Room, Green Room, and adjacent foyers and smaller rooms have been reserved for the use of the Congress. These rooms are located on the second floor of the hotel and provide ample space for registration rooms and ticket bureau, bulletin boards, etc., the Ball Room being used for the evening meetings.

Headquarters will be open on the afternoon of Saturday, October 21st, and on Sunday, the 22d, for the registration of members. The program of clinics and demonstrations for Monday will be bulletined on Saturday afternoon, and on each afternoon, beginning on Monday, the complete program for the next day's clinics will be posted on bulletin boards in headquarters. A printed program will be issued each morning and special tickets for all clinics and demonstrations will be issued to members at 8 a.m. each day of the session.

SPECIAL TICKETS

The use of special tickets at previous sessions has fully demonstrated the efficacy of this method of providing for the distribution of members among the various clinics. To prevent overcrowding, tickets for any clinic or demonstration are limited in number to the actual capacity of the room in which the clinic or demonstration is to be given. These special tickets will be issued at 8 o'clock each morning for the clinics and demonstrations to be held that day, a complete clinical schedule having been posted on the bulletin board on the afternoon of the preceding day, and a printed schedule of the clinics distributed early each morning.

PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY

Monday

CHARLES H. FRAZIER—University Hospital—9 to 12
 T. TURNER THOMAS—University Hospital—3 to 4
 I. G. ALFANDER—Episcopal Hospital—11 to 1
 HARRY C. DEWEY—Episcopal Hospital—1 to 5
 W. WAYNE BABCOCK—Samaritan Hospital—9 to 12
 WILLIAM A. STEEL—Samaritan Hospital—2 to 4
 M. BEHRND—Jewish Hospital—2 to 5
 KATE W. BALDWIN—Woman's Hospital—3

Tuesday

H. R. OWEN—Philadelphia General Hospital—11
 H. R. LOUN—Philadelphia General Hospital—2 to 4
 J. B. CARNETT—University Hospital—9 to 10
 A. C. WOOD—University Hospital—10 to 12
 W. WAYNE BABCOCK—Samaritan Hospital—9 to 12
 ALFRED HEINBERG—Mt. Sinai Hospital—10 to 12
 LEON BRINKMAN—Mt. Sinai Hospital—1 to 3
 A. P. C. ASHURST—Episcopal Hospital—9 to 1
 L. H. MITSCHLER—Episcopal Hospital—2 to 4
 NATHANIEL GINSBURG—Jewish Hospital—9 to 12
 WILLIAM H. TELLER—Jewish Hospital—2 to 5

Wednesday

EDWARD MARTIN and staff—University Hospital—9 to 12
 I. L. ELISON—University Hospital—1 to 2
 W. P. HARM—Philadelphia General Hospital—9 to 11
 CHARLES HIRSCH—Mt. Sinai Hospital—10 to 12
 A. P. C. ASHURST—Episcopal Hospital—9 to 1
 NATHANIEL GINSBURG—Jewish Hospital—9 to 12
 M. BEHRND—Jewish Hospital—2 to 5
 W. B. VAN LENSEN and H. L. NORTHROP—Hahnemann Hospital—2 to 3
 FRANCES SPRAGLE—Woman's Hospital—3

Thursday

T. TURNER THOMAS—Philadelphia General Hospital—9 to 11
 W. WAYNE BABCOCK—Samaritan Hospital—9 to 12
 WILLIAM A. STEEL—Samaritan Hospital—2 to 4
 CHARLES H. FRAZIER—University Hospital—9 to 12
 G. P. MCELDER—University Hospital—1 to 2
 I. G. ALFANDER—Episcopal Hospital—11 to 1
 HARRY C. DEWEY—Episcopal Hospital—1 to 5
 ALFRED HEINBERG—Mt. Sinai Hospital—10 to 12

NATHANIEL GINSBURG—Mt. Sinai Hospital—2 to 4
 M. M. FRANKLIN—Jewish Hospital—9 to 12
 WILLIAM H. TELLER—Jewish Hospital—2 to 5
 W. B. VAN LENSEN—Hahnemann Hospital—11.

Friday

JOHN B. DEWEY—University Hospital—10 to 12
 DAMON B. PFIFFER—University Hospital—1 to 2
 A. P. C. ASHURST—Episcopal Hospital—9 to 1
 MAX STALLER—Mt. Sinai Hospital—9 to 12
 LEON BRINKMAN—Mt. Sinai Hospital—2 to 4
 NATHANIEL GINSBURG and M. M. FRANKLIN—Jewish Hospital—9 to 12
 WILLIAM H. TELLER and M. BEHRND—Jewish Hospital—2 to 5
 KATE W. BALDWIN—Woman's Hospital—3
 H. L. NORTHROP and G. A. VAN LENSEN—Hahnemann Hospital—2 to 3

Saturday

THOMAS R. NELSON—Episcopal Hospital—11 to 3

Days and Hours to be Announced

JOHN A. HOGUE—Stetson Hospital
 LEON BRINKMAN—St. Agnes' Hospital
 J. CHALMERS D'ARCO—Jefferson Hospital
 HARRY C. DEWEY—Women's College and Kensington Hospitals
 JOHN B. DEWEY—German Hospital
 GEORGE M. DORRANCE—St. Agnes' Hospital
 E. L. ELISON—Howard Hospital
 M. M. FRANKLIN—St. Joseph's Hospital
 JOHN GIBSON—Jefferson Hospital
 L. J. HAYMOND—Methodist Hospital
 EDWARD B. HODGE—Presbyterian Hospital
 JOHN I. N. JONES—St. Joseph's Hospital
 J. H. JORSON—Presbyterian and Polyclinic Hospitals
 JAMES A. KELLY—St. Joseph's Hospital
 ERNEST J. LACEY—Medico-Chirurgical Hospital
 BERNARD MENCKE—Stetson Hospital
 G. P. MCELDER—St. Agnes' Hospital
 CHARLES NASSAU—St. Joseph's Hospital
 G. G. ROSS—German and Stetson Hospitals
 FRANK J. STEWART—Jefferson Hospital
 WILLIAM J. TAYLOR—St. Agnes' Hospital
 H. R. WHARTON—Presbyterian Hospital
 A. D. WHITING—German Hospital
 A. C. WOOD—Howard Hospital

GYNECOLOGY AND OBSTETRICS

Monday

THEO A. FECK—Gyneccean Hospital—10 to 11
 BARTON COOKE HIRST and JOHN COOKE HIRST—How-
 and Hospital—11
 F. E. MONTGOMERY—Jefferson Hospital—11 to 1
 JOHN M. FISHER—St. Agnes' Hospital—9 to 11
 WILLIAM D. CLINE—West Philadelphia General Hospi-
 talic Hospital—10
 LIDA STEWART COGILL—Woman's Hospital—9
 SARAH H. LOCKERY—Woman's Hospital—10

JOHN G. CLARK and staff—University Hospital—9 to 12.

Tuesday

GEORGE W. OUTFRIDGE—Gyneccean Hospital
 BROOKE M. ANSPACH—Gyneccean Hospital
 D. B. JAMES and N. F. LANE—Hahnemann Hospital—
 2 to 3
 EDWARD P. DAVIS—Jefferson Hospital—11
 F. E. MONTGOMERY—Jefferson Hospital—1 to 2
 WILLIAM L. PARRE—Kensington Hospital—11

JOHN H. GIVIN and GEORGE I. SHOEMAKER — Presbyterian Hospital — 12.
 JOHN A. MCGINN — St Agnes' Hospital — 11.
 P. BROOKE BLAND — St Joseph's Hospital
 BARTON COOKE HIRST — University Hospital — 9
 SARAH H. LOCKREY — West Philadelphia Hospital for Women — 11 to 1
 ELLA W. GRIM — Woman's Hospital — 9
 MARIE K. FORMAD — Woman's Hospital — 10

Wednesday

THEO A. FRICK — Gynecean Hospital — 10 to 1
 BARTON COOKE HIRST and JOHN COOKE HIRST — Howard Hospital — 11.
 I. E. MONTGOMERY — Jefferson Hospital — 11 to 1
 I. F. DAVIS — Philadelphia General Hospital — 2 to 4
 JOHN A. MCGINN — St Agnes' Hospital — 11
 P. BROOKE BLAND — St Joseph's Hospital
 J. C. APPEGATE — Samaritan Hospital — 11 to 12
 BROOKE M. ANSPACH — University Hospital — 9 to 12
 CAROLINE M. PLURFELL — Woman's Hospital — 10

Thursday

GEORGE W. OUTERBRIDGE — Gynecean Hospital
 BROOKE M. ANSPACH — Gynecean Hospital
 D. B. JAMES and N. I. LANE — Hahnemann Hospital — 2 to
 JOHN M. FISHER — Jefferson Hospital — 12 to 1
 J. M. FISHER — Philadelphia General Hospital — 2 to 4
 JOHN H. GIVIN and GEORGE I. SHOEMAKER — Presbyterian Hospital — 12

JOHN A. MCGINN — St Agnes' Hospital.
 P. BROOKE BLAND — St Joseph's Hospital
 JOHN G. CLARK and staff — University Hospital — 9 to 12
 WILLIAM D. CLIN — West Philadelphia General Homeopathic Hospital — 10
 SARAH H. LOCKREY — West Philadelphia Hospital for Women — 11 to 1
 MARY T. MILLER — Woman's Hospital — 9
 SARAH H. LOCKREY — Woman's Hospital — 10

Friday

THEO A. FRICK — Gynecean Hospital — 10 to 1
 BARTON COOKE HIRST and JOHN COOKE HIRST — Howard Hospital — 11
 WILLIAM I. PARKE — Kensington Hospital — 11
 JOHN A. MCGINN — St Vincent's Hospital
 M. LOUISE DIEZ — Woman's Hospital — 9
 CATHERINE MACFARLANE — Woman's Hospital — 10

Saturday

P. BROOKE BLAND — Jefferson Hospital — 11 to 1.
 BARTON COOKE HIRST — University Hospital — 9
 JOHN G. CLARK and staff — University Hospital — 9 to 11

Days to be announced

RICHARD C. NORRIS — Methodist Hospital
 WILLIAM R. NICHOLSON — Methodist Hospital
 SIFFERT F. FRACY — Stetson Hospital
 GEORGE M. HOYD — Medico-Chirurgical and Philadelphia Lying in Charity Hospitals

ORTHOPEDIC SURGERY

Monday

J. T. RUGH and staff — Methodist Hospital — 4 to 5
 A. B. GILL — Episcopal Hospital — 2 to 5

Tuesday

M. M. FRANKLIN — Philadelphia General Hospital — 11 to 1
 J. T. RUGH and staff — Methodist Hospital — 4 to 5
 H. A. WILSON and staff — Jefferson Hospital — 11 to 1
 W. J. TAYLOR and staff — Orthopedic Hospital — 11 to 1
 J. P. MANN — Medico-Chirurgical Hospital — 2 to 3
 HARRY HUDSON and staff — Samaritan Hospital — 2 to 4
 G. G. DAVIS and staff — University Hospital — 2 to 3

Wednesday

G. G. DAVIS and staff — University Hospital — 2 to 4
 J. T. RUGH and staff — Methodist Hospital — 4 to 5
 A. B. GILL — Episcopal Hospital — 9 to 12

Thursday

H. A. WILSON and staff — Jefferson Hospital — 11 to 1
 J. T. RUGH and staff — Methodist Hospital — 4 to 5
 G. G. DAVIS and staff — Orthopedic Hospital — 11 to 1
 J. P. MANN — Medico-Chirurgical Hospital — 2 to 3
 J. K. YOUNG and staff — Polyclinic Hospital — 2 to 5
 G. G. DAVIS and staff — University Hospital — 2 to 3

Friday

J. T. RUGH and staff — Methodist Hospital — 4 to 5
 G. G. DAVIS — Widener School — 2 to 4
 G. G. DAVIS and staff — University Hospital — 2 to 3
 J. K. YOUNG — Philadelphia General Hospital — 2 to 4
 J. T. RUGH — Philadelphia General Hospital — 11 to 1
 DUDLEY J. MORTON — Hahnemann Hospital — 11

Saturday

J. T. RUGH and staff — Methodist Hospital — 4 to 5
 A. P. C. ANHURST and staff — Orthopedic Hospital — 9 to 11
 H. A. WILSON and staff — Jefferson Hospital — 11 to 1

GENITO-URINARY SURGERY

L. T. ASHCRAFT — Hahnemann Hospital — Tuesday, 11
 H. M. CHRISTIAN — Medico-Chirurgical Hospital
 H. R. LOUX and staff — Jefferson Hospital
 T. R. NELSON — University Hospital
 L. T. ASHCRAFT — Women's Homeopathic Hospital

E. H. SITER — Philadelphia General Hospital
 E. H. SITER and staff — University Hospital
 B. A. THOMAS — Polyclinic Hospital
 A. A. UHLE and WILLIAM MACFARLANE — German Hospital — Monday and Friday

ROENTGENOLOGY

Monday

- SIDNEY FELDSTFEN — Jewish Hospital — 3 to 4 Obscure and interesting fractures
 W. S. NEWCOMET — Presbyterian Hospital — 2 to 3 Bone lesions Sinus cases (in conjunction with Dr Stauffer).
 GEORGE E. PFAHLER — Medico-Chirurgical Hospital — 2 30 to 3 30 Roentgenotherapy in the treatment of deep-seated malignant disease

Tuesday

- DAVID R. BOWEN — Pennsylvania Hospital — 1 to 2 Fractures
 FREDERICK C. HUTTON — 1438 N. 15th St — 10 to 12 Organic lesions of the stomach and duodenum
 W. F. MANGES — Jefferson Hospital — 2 to 3 Pycloscopy and pyclography
 W. S. NEWCOMET — Presbyterian Hospital — 2 to 3 Bone lesions Sinus cases (in conjunction with Dr Stauffer).
 GEORGE E. PFAHLER — Medico-Chirurgical Hospital — 2 30 to 3 30 Roentgen diagnosis of gastric and duodenal lesions: Lantern slide demonstration

Wednesday

- W. F. MANGES — Jefferson Hospital — 2 to 3 Fluoroscropy of the gastro intestinal tract
 W. S. NEWCOMET — Presbyterian Hospital — 2 to 3 Bone lesions Sinus cases (in conjunction with Dr Stauffer).
 GEORGE E. PFAHLER — Medico-Chirurgical Hospital — 2 30 to 3 30 Roentgen diagnosis of gall stones
 DAVID R. BOWEN — Pennsylvania Hospital — 1 to 2 Bone and joint diseases
 M. K. FISHER — Stetson Hospital — Joint diseases and radiography of the urinary tract
 JACOB W. FRANK — Hahnemann Hospital — 9

Thursday

- DAVID R. BOWEN — Pennsylvania Hospital — 1 to 2 Surgical diseases of the thorax
 SIDNEY FELDSTFEN — Jewish Hospital — 3 to 4 Tuberculosis of the lungs
 FREDERICK C. HUTTON — St. Mary's Hospital — 3 to 5. Intestinal pathology
 W. F. MANGES — Office — 2 to 3 Brain tumor and intracranial lesion
 W. S. NEWCOMET — Presbyterian Hospital — 2 to 3 Bone lesions Sinus cases (in conjunction with Dr. Stauffer)

Friday

- DAVID R. BOWEN — Pennsylvania Hospital — 12 to 1. The management of small and medium sized hospital roentgen laboratories
 W. F. MANGES — Office — 2 to 3 Roentgen examination of teeth as an aid to surgical diagnosis
 W. S. NEWCOMET — Presbyterian Hospital — 2 to 3 Bone lesions Sinus cases (in conjunction with Dr. Stauffer).
 GEORGE E. PFAHLER — Medico-Chirurgical Hospital — 2 30 to 3 30 Electro-coagulation in the treatment of malignant disease
 M. K. FISHER — Stetson Hospital — Joint diseases and radiography of the urinary tract
 JACOB W. FRANK — Hahnemann Hospital — 9

Saturday

- DAVID R. BOWEN — Pennsylvania Hospital — 12 to 1. The management of small and medium-sized hospital roentgen laboratories
 W. S. NEWCOMET — Presbyterian Hospital — 2 to 3 Bone lesions Sinus cases (in conjunction with Dr. Stauffer)

Days to be Announced

- HENRY K. PANCOAST — University Hospital — 9 to 10. Radium therapy, 3 to 4, Gastro-intestinal tract

SURGERY OF THE EYE

Monday

- WILLIAM CAMPBELL POSEY — Howard Hospital — 2
 S. LEWIS ZIEGLER — Wills Eye Hospital — 2
 SAMUEL D. RISLEY — Wills Eye Hospital — 2
 MCCLUNEY RADCLIFFE — Wills Eye Hospital — 2
 WILLIAM M. SWEET — Wills Eye Hospital — 3
 PAUL PONTIUS — Wills Eye Hospital — 2
 L. PETER — Polyclinic Hospital — 1
 PAUL PONTIUS — St. Joseph's Hospital — 3 30
 FREDERICK KRAUSS — Episcopal Hospital — 2
 LOUIS LOVE — St. Mary's Hospital — 3
 ARON BERN — Jewish Hospital — 3
 I. D. FUNK — Jefferson Hospital — 2

Tuesday

- E. D. FUNK — Jefferson Hospital — 2
 WILLIAM T. SHOEMAKER — Pennsylvania Hospital — 2
 GEORGE S. CHAMPTON — Pennsylvania Hospital — 2
 WILLIAM W. SPEAKMAN — Hahnemann Hospital — 2
 WILLIAM CAMPBELL POSEY — Wills Eye Hospital — 2
 P. N. K. SCHWENK — Wills Eye Hospital — 1 30

- T. B. HOLLOWAY — Polyclinic Hospital — 1
 MARY BUCHANAN — Woman's Hospital — 2
 G. ORAM KING — Episcopal Hospital — 2
 AARON BRAV — Lebanon Hospital — 2
 H. T. HANSELL — Philadelphia General Hospital — 2 to 3
 MCCLUNEY RADCLIFFE and J. M. GRISCOM — Presbyterian Hospital — 2
 WILLIAM ZENTMAYER — Wills Eye Hospital — 2
 G. E. DE SCHWEINITZ and J. T. CARPENTER — University Hospital — 3
 G. E. DE SCHWEINITZ — University Hospital — 5

Wednesday

- CHARLES W. LEFEVER and S. J. GITTELSON — Mt. Sinai Hospital — 3
 E. D. FUNK — Jefferson Hospital — 2
 L. WEBSTER FOX — Medico-Chirurgical Hospital — 1
 S. LEWIS ZIEGLER — Wills Eye Hospital — 2
 SAMUEL D. RISLEY — Wills Eye Hospital — 2
 MCCLUNEY RADCLIFFE — Wills Eye Hospital — 3
 WILLIAM M. SWEET — Wills Eye Hospital — 2
 PAUL PONTIUS — Wills Eye Hospital — 2

WENDELL REBER — Polyclinic Hospital — 1
 WILLIAM T. SHOEMAKER — German Hospital — 1.
 CHARLES J. JONES — St. Joseph's Hospital — 3
 MIRIAM M. BUTT — Woman's Hospital — 2
 H. G. GOLDBERG — Episcopal Hospital — 2
 LOUIS LOVE — St. Mary's Hospital — 3
 J. C. KNIFE — Jewish Hospital — 2
 JOHN W. CROSKY — Philadelphia General Hospital — 2
 I. A. SHUMWAY — Philadelphia General Hospital — 3
 T. B. HOLLOWAY, H. M. LANGDON and CARL WILLIAMS — University Hospital — 5

Thursday

PHILIP H. MOORE — Methodist Hospital — 3
 J. A. KEARNEY — St. Agnes Hospital — 3
 J. C. KNIFE — Jefferson Hospital — 3
 E. D. FUNK — Jefferson Hospital — 2
 WILLIAM T. SHOEMAKER — Pennsylvania Hospital — 2
 GEORGE S. CRAMPTON — Pennsylvania Hospital — 2
 WILLIAM CAMPBELL POSEY — Wills Eye Hospital — 2
 P. N. K. SCHWENK — Wills Eye Hospital — 1, 30
 WILLIAM ZENTMAYER — Wills Eye Hospital — 2
 L. APPLEMAN — Polyclinic Hospital — 1
 MARY BUCHANAN — Woman's Hospital — 2
 FREDERICK KRAUSS — Episcopal Hospital — 2
 AARON BRAV — Lebanon Hospital — 2
 JAMES THORINGTON and J. M. GRISCOM — Presbyterian Hospital — 2
 G. E. DE SCHWARTZ and I. A. SHUMWAY — University Hospital — 3

H. F. HANSELL — Philadelphia General Hospital — 2 to 3

Friday

H. F. HANSELL and WILLIAM M. SWEET — Jefferson Hospital — 2, 45
 S. LEWIS ZIEGLER — Wills Eye Hospital — 2
 SAMUEL D. RISLEY — Wills Eye Hospital — 2
 McCUNEY RADCLIFFE — Wills Eye Hospital — 2
 PAUL PONTIUS — Wills Eye Hospital — 2
 E. A. SHUMWAY and H. M. LANGDON — Children's Hospital — 2
 WENDELL REBER — Polyclinic Hospital — 1
 L. PEYER — Polyclinic Hospital — 5
 WILLIAM T. SHOEMAKER — German Hospital — 1
 CHARLES J. JONES — St. Joseph's Hospital — 3
 G. ORAM KING — Episcopal Hospital — 2
 LOUIS LOVE — St. Mary's Hospital — 3
 E. D. FUNK — Jefferson Hospital — 2
 AARON BRAV — Jewish Hospital — 3

Saturday

E. D. FUNK — Jefferson Hospital — 2
 WILLIAM T. SHOEMAKER — Pennsylvania Hospital — 2
 GEORGE S. CRAMPTON — Pennsylvania Hospital — 2
 P. N. K. SCHWENK — Wills Eye Hospital — 1, 30
 WILLIAM ZENTMAYER — Wills Eye Hospital — 2
 H. G. GOLDBERG — Episcopal Hospital — 2
 AARON BRAV — Lebanon Hospital — 2
 WILLIAM CAMPBELL POSEY — Wills Eye Hospital — 2

SURGERY OF THE EAR, NOSE, AND THROAT

Monday

CHARLES P. GRAYSON — University Hospital — 2
 R. SKILLERN — Medico-Chirurgical Hospital — 2
 I. JONES — Blockley Hospital — 2
 MARGARET BUTLER — Woman's Hospital — 2
 CURTIS EVES — Episcopal Hospital — 2

Tuesday

F. R. PACKARD — Pennsylvania Hospital — 2
 D. B. KYLE — Jefferson Hospital — 1, 2
 R. SKILLERN — Medico-Chirurgical Hospital — 2
 I. G. SHALLCROSS and H. S. WEAVER — Hahnemann Hospital — 2, 30
 FRED W. SMITH and OSCAR SEELEY — Hahnemann Hospital — 2, 30
 CHARLES C. BIEDERT — Episcopal Hospital — 2
 LAURA E. HUNT — Woman's Hospital — 2

Wednesday

WALTER ROBERTS — Polyclinic Hospital — 2
 RALPH BUTLER — Polyclinic Hospital — 3
 R. SKILLERN — Medico-Chirurgical Hospital — 2
 I. G. SHALLCROSS and H. S. WEAVER — Hahnemann Hospital — 2, 30
 FRED W. SMITH and OSCAR SEELEY — Hahnemann Hospital — 2, 30

CURTIS EVES — Episcopal Hospital — 3

Thursday

GEORGE M. COATES — Polyclinic Hospital — 1
 I. G. SHALLCROSS and H. S. WEAVER — Hahnemann Hospital — 2, 30
 FRED W. SMITH and OSCAR SEELEY — Hahnemann Hospital — 2, 30
 CHARLES C. BIEDERT — Episcopal Hospital — 2

Friday

SETH MACCARTHY SMITH — Jefferson Hospital — 1, 30
 GEORGE M. COATES — Pennsylvania Hospital — 1
 I. G. SHALLCROSS and H. S. WEAVER — Hahnemann Hospital — 2, 30
 FRED W. SMITH and OSCAR SEELEY — Hahnemann Hospital — 2, 30
 GILBERT J. PALEY — Hahnemann Hospital
 CHARLES C. BIEDERT — Episcopal Hospital — 2
 MARGARET WARLOW — Woman's Hospital — 2

Days to be announced

ARTHUR WATSON — Polyclinic Hospital
 G. HUDSON MAKUEN — Polyclinic Hospital
 ALEXANDER RANDALL — University Hospital
 CHARLES P. GRAYSON — Medico-Chirurgical Hospital

